University of Cambridge School of Agriculture Memoirs

Memoir No. 28

A summary of the papers published by the members of the Staff of the School of Agriculture and its Associated Research Organisations during the period Oct. 1st, 1955—Sept. 30th, 1956.

Review Series

No. 11. Agricultural Teaching at Cambridge, 1894—1955

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FOREWORD

This Memoir, which is published under the general editorship of the Librarian of the School, represents an attempt to present as succinctly as possible by means of author summaries the contributions made by members of the Staff of the School of Agriculture and its Associated Research Organisations to the development and progress of Agricultural Science, to indicate to research workers interested the Journals in which the full papers are presented and to act as a complete record of papers published.

Requests for further information or criticism arising out of the summaries should be referred to the individual author concerned ; criticisms and suggestions for the improvement of the Memoir itself should be addressed to the Librarian of the School.

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AGRICULTURAL TEACHING AT CAMBRIDGE 1894—1955*

By

SIR FRANK L. ENGLEDOW, C.M.G., M.A., F.R.S.

(*Drapers Professor of Agriculture*)

Aims and Methods

This retrospect traces the development of principles which have come to underlie the teaching of agriculture at Cambridge and illustrates the manner of their application. At the start, sixty years ago, the aim was to train lecturers who, working among landowners and farmers, would promote a governmental plan for improving British farming. Successful teaching and the increasing influence of science in agriculture, soon enlarged both aims and student numbers. Prolonged depression in the national agriculture followed by the food crisis of the 1939-45 War, left their strong impress on both teaching and research. Moreover, expansion of agriculture, with its novel problems, in other parts of the British Commonwealth, the tropical in particular, awakened interest in the relationship between traditional British husbandry practices and universally valid principles.

The Start

On the proposal before the University in 1899 to raise agriculture to a University Department with a Chair, it was commented " however harmless it may be to try an experiment in this direction, the question whether these ' bread studies ' are really things a University should touch is a very open one ". Fifty years later (31 January, 1956) the University, now familiar with vocational teaching and applied science, showed itself in public discussion divided and bewildered as to its growth in science and technology. Prejudice in 1899 has changed to academic puzzlement by 1955. Agriculture has influenced and been influenced by this transition.

By 1908 teaching was thought desirable for two distinct classes : future owners or managers of estates ; and those seeking careers as specialists in some branch of agricultural science (mostly abroad). There was apparently, as yet, no demand, or at any rate no provision, for the training of farmers. The two-year Diploma course, instituted a few years previously, had involved a first year of elementary science, with no agriculture, and a second of agriculture only—a separation since debated many times in many places. Part I was accepted as one of three Special Examinations for the Ordinary Degree in hope of attracting the many undergraduates destined to own or manage estates but for whom at least two years of the humanities were deemed necessary. They had, however, shown no liking for science without agriculture. Part II was mainly taken by intending specialists most of whom, proceeding from the Natural Sciences Tripos, were excused Part I. The courses were therefore changed. In Part I agriculture and the sciences (with special reference to agriculture) were united and this principle has ruled ever since for students destined for the practical side. For Part II there was agriculture and botany and chemistry, all more advanced and specialised than in Part I. Much was recognised to be missing but there was already concern at the vast range of knowledge pertaining to agriculture and the overloading of the courses. But the very capable and industrious were encouraged by " voluntary " papers in other than the prescribed sciences. Voluntary courses and courses with no examination remain with us still though vestigially. In this early period can be plainly seen the strong effect on teaching of the teachers' own researches, giving entity to the subjects and, as the old examination papers show, steadily raising levels.

The Degree Course Instituted

Strong, varied, influences bore on teaching in the years 1919 to 1939, effecting great changes. War I stimulated science in all industry, its food shortages re-arousing the interest, apparent by 1914, in the possibilities offered by researches which included Biffen's genetics and plant

* *This is the eleventh of a series of articles summarising phases of agricultural research particularly associated with the School of Agriculture since its inception, previous contributions having dealt with :—Physiology of Reproduction, Plant Virus Research, Plant Breeding, Animal Nutrition, Horticulture, Agricultural Economics, Field-Drainage, Animal Production, the Cambridge University Farm, and Crop Husbandry. Further contributions on other work will appear in future issues.*

breeding at Cambridge. Research Institutes, financed by government, steadily expanding, gave teaching the stimulus of new knowledge. A wartime campaign of ploughing up and cropping old grass revealed both the limitations of science on the land and the marked range between good farmers and bad. Agricultural Advisory Services were therefore enlarged, the School becoming the Eastern Counties centre for specialist advice. It was accepted, also, that a full degree course in Agriculture was necessary for the modern farmer and the practical adviser. Teaching was greatly strengthened by part-time help from the Research Institutes and Advisory Staffs.

In the decade from 1921 acute depression in British farming gave a new turn to agricultural economics. Formerly, as a teaching subject, it was restricted to commentation from general economic theory. With government support, centres for economic survey, research and advice were developed, the School housing one for the Eastern Counties. Teaching in husbandry, as well as in economics, was greatly benefited, for authentic production costs and other factual information about various systems challenged and corrected the subjective views and generalisations from local experience formerly prevailing in it. The horse lost its place on the land in this period and lecture courses moved from Agricultural Engineering at large to Implements and Machines and developed a close alliance with teaching in husbandry. Statistical analysis in relation to agricultural and biological experimentation gained its first place in this country by a Lectureship in 1912 for G. Udny Yule in the School (it became a Readership in 1931). Becoming firmly established after War I in both advanced teaching and in experimentation, it invigorated all the subjects, husbandry in particular. In 1923 the University Farm was doubled in size, becoming 450 acres ; and by additions (Ladysmith and Moor Barns) in 1930 and 1944, it grew to its present 700 acres. Its functions became and remain three-fold. Primarily, it is run commercially, for profit, so that in husbandry lectures, in farm classes and in weekly talks by its Director what is said may be effectively illustrated by what is done. Farm buildings were and are now the simple essentials, the view being that while alternative lay-outs and new developments in buildings are not practically demonstrable by using any one farm, their basic principles are. The Farm's second function has been to provide sites for small field laboratories, animal accommodation or plot land for researches by teachers or research institute staffs. These are wholly separated, in management and financially. Provision for crop and animal husbandry experimentation, by the agricultural teachers, is the Farm's other function. Its normal crops, grassland and livestock are used as fully as possible, special field plots or extra stock being provided where necessary. Sampling methods have enabled much use to be made of this plan which secures both economies and practical conditions.

Post Graduate Teaching

Post-graduate teaching, supplied by Part II of the original Diploma, grew strongly between the two Wars. Recruitment for overseas posts by scholarships for science or agricultural graduates destined for general agriculture or for research, was instituted by the Empire Cotton Growing Corporation in 1921. After a year at Cambridge with teaching adjusted to their provenance, the scholars spent a year at the Imperial College of Tropical Agriculture, Trinidad, proceeding thence to their posts in Colonial Territories. Others, and especially the Colonial Office, adopted this plan for overseas services and corresponding ones were developed for advisory and research services at home. A concerted unity for the two-year course became an aim at the two centres and remains so for Colonial Office Probationers. The post-graduate body became large and highly diversified in provenance and destination. Wide interest in agriculture and the scope it offers to science, created thus by teaching, was furthered by visits of the staff to tropical and other territories. To meet the varied student interests, teaching in husbandry gradually widened and presented customary farming systems and practices less as isolated information and more as resultants of physical, biological, economic and social factors. In the technical and scientific subjects, too, a stimulating and widening was felt.

At its institution in 1919 the degree course had agriculture as a subject in all three years, the agricultural science spread over the first two years, while in the third were also economics, law, accountancy, surveying and building construction. Some of the technical subjects were included because degrees in Estate Management and Forestry (and later Horticulture) were also introduced, lecture courses being made to do as much common service as possible. Later on,

Estate Management with its strong urban interests, became a separate Department of the University. Both Forestry and Horticultural courses were given up by the University after a few years because students were few and the number of teaching centres for these subjects, in the country, excessive.

The Double Purpose Degree: An Experiment

The Diploma course, changed in 1919 the better to suit intending research workers and specialist advisers, drew many students. Five years later it was deemed desirable to provide a second type of preparation for these careers by introducing an optional, alternative form into the Degree course. Years I and II were in common but in year III a choice was offered of agriculture with technical subjects (law, accountancy, engineering, veterinary subjects) or agriculture with specialisation in one agricultural science. The view was thus taken that for the specialist in an agricultural science, scientific foundations can be laid by elementary courses designed for intending farmers and general advisers. After five years experience this view was abandoned and has never been re-adopted.

The Degree course was therefore restored to its purpose of educating intending farmers and (with post-graduate work) practical advisers. Secondary changes were introduced, from time to time, up to 1939, prompted by teaching experience. Burdensomeness of the course, perpetually threatening, arose in part from the overlap of subjects, which is hard to avoid in an agricultural course. Its regulation has come to be effected by informal arrangements among groups of teachers. The alternative of closely particularised examination schedules is thought to make it hard for a teacher to change his presentation progressively and, on a change of incumbency, for the newcomer to take his own line. The sciences, making their way into drainage, grassland, animal feeding and other matters seemed for a time to threaten husbandry as a teaching subject with exiguousness. But husbandry, now statistically equipped, was everywhere developing its own experimentation. Moreover, the teaching of principles deriving from greater knowledge of climatic and other physical factors, more and more displaced descriptions of local practice. Study of the national agriculture (in aspects other than the primarily economic) also developed as part of the the teaching in husbandry. Agricultural law was omitted while book-keeping and farm buildings were greatly reduced.

Frequent consideration left unchanged the decision to impose no formal requirement as to practical farm experience before entry. A big majority of candidates come from farms. For the others, the value of prior experience is pointed out in advance and farm work in University vacations advised. Decision must be left to the candidate. This view, still held, is supported by the high success of the considerable number whom rigid rules would have debarred or delayed.

Investigation as a Teaching Method

On the resumption of normal University study in 1919 the Diploma was re-shaped to provide for the many graduates in science or in agriculture destined for research or advice-cum-administration (from 1924 and especially after 1928 mostly in the tropics). Five years later more specific preparation for research was deemed necessary. The course, under the new name of Diploma in Agricultural Science, was therefore reconstituted: in the first year agriculture and a prescribed group of agricultural sciences (varied according to the candidates' future specialism): in the second year study of one subject by advanced lectures, private reading, some investigational work and the writing of a Thesis or Essay. Every candidate had an appointed Supervisor for his reading and investigation. The Essay was to present the results of the investigation and also a critical review of the relevant literature. Literary training and experience in presentation, in mind in requiring the Essay, were considered not less necessary than experience of research. Candidates intending to specialise in an agricultural science had, as a rule not reached a high level in the cognate pure science. For some of them lectures for Part II of the Natural Sciences Tripos were suitable, but no teaching specifically for them was attempted. The Diploma could be taken not only in an agricultural science or in economics but in crop husbandry or animal husbandry or tropical agriculture. For these last three, and for them only, graduates in agriculture were eligible, only the second year's work being required of them. In other subjects an approved honours degree in science was necessary.

This post-graduate teaching, continuing without major alteration up to 1946, led to certain plain conclusions. Tropical agriculture, in whatever guise, soon proved unamenable to treatment in England. Candidates in an agricultural science were not, as a rule, able to advance themselves adequately by directed reading : they had not the foundational strength in pure science which a further year in its schools would have given. These also lacked time and inclination to acquire an appropriate knowledge of agriculture itself, in their first year, from teaching which had to serve also for the science graduate with practical interests. Investigation—a requirement of the course—took up inordinate time for both the scientific and the practical type of candidate. Few were mature enough in knowledge and outlook to benefit much from it. The Essay proved an even more undesirable element. It was often excessively long, set narrow limits to the candidate's thought, interest and reading, and induced obsession. Its burden lay heavily also on supervisors and examiners.

Two valuable teaching methods were developed in the course. Weekly discussions for the whole graduate class, each member offering a paper for discussion during the year, ensured practice in presentation and in criticism, vigour with caution. The second of these developments was in outdoor teaching. Classes on the University Farm and visits to other farms are indispensable illustrations in teaching husbandry. For men training for little-developed tropical places, capacity to observe the influence of major physical factors on agricultural practices and possibilities must be developed. Cross country walks, of two to five miles, on reconnoitred routes, with verbal reports at the finish, therefore came into use. Written reports proved desirable and are now compulsory. Specialists as well as general agriculturalists took part. Explanation during the walk was solely for the strict requirements of the exercise. This method, still in regular use, developed several variations, all preserving the primary aim.

After the 1939-45 War

By 1939 changes in Degree teaching and greater ones for the Diploma were therefore in mind. They had to wait till war was over and by then great alterations in the School's circumstances were imminent. Government had decided to take the Research Institutes into its charge and to enlarge them greatly on new sites. The Advisory Service was nationalised, its specialist officers transferring to the several newly made Provincial Centres. Husbandry Experiment Farms for all the major ecological-agricultural regions of the country were also provided for. Grants for Agricultural Departments of Universities ceased to be direct and came, as for other Departments, from University revenue. The School, reaching a fresh historical phase, became a normal University Department with the traditional bond between imparting and enlarging knowledge. Research was left to be directed only by the teacher's bent, subject to an inherent obligation towards the interests of agricultural progress. Research resources, in staff and large equipment, were very much reduced but so, too, was the field of obligation. For the country's Research Institutes provided handsomely now for the large, long continuing researches and routine investigations which, requiring costly equipment, could not be relinquished or much modified upon change of incumbency. In husbandry, likewise, work of corresponding nature was fully taken in charge by the Husbandry Experimental Farms. Personal collaboration between Universities and governmental institutions was naturally hoped for and various grants from the Agricultural Research Council were made available for agreed work in the Universities. Substantially, however, University research in agriculture acquired that vital liberty to follow its own curiosity. Major problems of agriculture cannot fail to be lodestars but fundamental interest is relieved of any check on account of practical urgency.

Influences on outlook in agricultural teaching and research from the first great war of the century were national in scale. Those of the 1939-45 War had a world-wide setting. The perspective of agricultural problems, immediate and more distant, was strikingly, indeed alarmingly changed. War and after-war questions of adequacy of food supply bore directly and stimulatingly on some of the main trends of thought already current in the School in 1939.

Developments in agriculture and agricultural science, at home and abroad, emphasised the need for the changes in teaching already apparent in 1939. It was evident that the intending specialist in agricultural science must first obtain not only a good general knowledge in pure science, but also a high specialisation in one subject. Then, to equip him for using his chosen

science in agriculture, there are two requisites. He must get a general acquaintance with application in agriculture of his own and other nearly related sciences : secondly, he must grasp the principles underlying farming systems and practices, become familiar with the general circumstances of agriculture and, if possible, be led to a genuine interest in it. High specialisation in the application of his chosen science must, as in the past, be left to his noviature in a research institute.

War had induced among farmers a much wider use of scientific, mechanical and technical aids, the aids themselves becoming more numerous and complex. In the Degree course, therefore, every subject found its content enlarged. To avoid excess, teaching in husbandry must be yet more in terms of principles rather than practical details and in the agricultural sciences a greater knowledge of the pure sciences at entry must be assumed. To insist on certain standards at entry, by University regulation, is nevertheless undesirable. The balance of claims on time, among the subjects, had now been altered a good deal by the swift mechanisation of agriculture and by the greatly increased importance of farm organisation and management.

Balance of Subjects

Courses in preparation for farming and connected practical vocations contain three groups of subjects : first, crop and animal husbandry and use of power units, implements and machinery: second, the biological and physical sciences in relation to agriculture : third, economic history and theory in relation to agriculture, also organisation and management of the farm. Time allotted to each group should be regulated by its vocational and its educational value. A University education may be hoped to produce, besides successful practitioners, some initiators and some leaders of opinion. Chemistry and physics, of greater intellectual difficulty than the descriptive parts of biological sciences, may be claimed to have the greater educational value. Husbandry, in practice largely subjective, is intrinsically improved and more educative as teaching if based on studies of physical environment illustrated by comparative agriculture. This last connotes not only the agricultural industry in different countries but, more importantly, the systems which have arisen in each world climatic region under its varying social and general economic conditions. Mechanical power and contrivance may be variously presented. Use of cultivation implements may be detached to husbandry, and costings, equipment policy and capitalisation to economics : or all sections may be kept together in a separate course. Power units (tractors and motors) and machines (not cultivation implements) if treated as engineering, could claim educational value and a heavy share of teaching time. The different, always increasing, number of types in the power units and machines, even if just dealt with descriptively, could use many hours and a costly collection of full pieces or models. How much, in all these branches of "agricultural engineering " should be presented in a general course on agriculture? An intriguing parallel question arises in choosing lines of research by the teachers concerned.

Allocation of teaching time among these three subject groups is everywhere under long-term change. At Cambridge the sciences in application to agriculture at first predominated, husbandry ranking second. Later, these two groups tended everywhere to co-equality. From the 1920s onwards, economics (especially of the running of a farm) pressed in strongly. Since 1945 it has not uncommonly ousted a good deal of science teaching, especially in the U.S.A. Considerations of balance between subjects, as to which there can be no finality and must be continuing experiment, led in 1946 to considerable re-arrangement of the degree course. Details of its present form appear in the Handbook of the School. Agriculture comes into each of the three years in company with the appropriate sciences or technical subjects. First year agriculture comprises general principles including those of crop and animal husbandry, to ensure that the bearings of these on each other and on the sciences are in mind from the start and not left to piecemeal recognition in the succeeding years. A new subject in the third year, farm organisation and management, brings together matter formerly absent or ill-dispersed among several subjects. There is an essay paper in each of the three yearly examinations with a wide choice of subjects pertaining to agriculture and " The Examiners shall take into account literary style and capacity for exposition as well as the knowledge of the subject shown by the candidate ".

Two Branches of Post-Graduate Teaching

Post-graduate teaching leads now to two separate awards. The Diploma in Agriculture (a two-year course) is for men proceeding from a general science degree, e.g. Part I of the Natural Science Tripos at Cambridge, and aiming at general advisory work at home or abroad or for various commercial employments. Graduates in agriculture (of approved standard) are also admissible and take a " modified " (one year) course. For the future specialist, intent on research or advisory work, the Diploma in Agricultural Science provides a one-year course. Admission to this requires a high scientific standard, e.g. Parts I and II of the Natural Sciences or other appropriate Tripos at Cambridge. Separate lecture courses are given in all subjects, except agriculture, machinery, and economics of farm organisation and management, for Degree and Diploma candidates, experience of the difference in interests and in scientific knowledge having shown the need for this double provision. Lectures in agriculture serve both the Degree course and that for the Diploma in Agriculture. For the Diploma in Agricultural Science there is a separate course on basic principles and major practical topics of agriculture, designed to give informed interest rather than detailed knowledge. For both Diplomas field experimentation with appropriate statistical analysis are important subjects in preparation for careers involving laboratory or field experiments. There is no examination in the subject but questions on it may be set in the papers on agriculture (for the Diploma in Agricultural Science, Section D (Statistics) there is a written examination in field experimentation).

The requirement of an investigation with an Essay or Thesis based on it was removed, for reasons already explained, at the 1946 remodelling. Candidates for the Diploma in Agricultural Science, of whom a long, high, training in science is now required, are assumed to be competent in scientific writing and presentation of results and to need their year wholly for formal teaching and reading. For the Diploma in Agriculture, some participation in current husbandry experiments is required but not the former personal investigation, the Essay or Thesis being retained but in new form. A *critical* review of published literature is now required, of no more than 5,000 words. The subject is chosen by the candidate, with official approval. It must pertain to husbandry, while bringing into play viewpoints and knowledge from relevant agricultural sciences. Subjects primarily requiring scientific treatment are disfavoured, for this Diploma is directed to practical vocations. Ample reading and considerable time in preparation are expected and the Diploma is not awarded unless the examiners approve the Essay. The aim is to give experience with technical literature and practice in planning and executing a writing. Such practice proves not less necessary as the time goes on. At an early stage a discussion class is used to put before the candidates, interrogatively rather than didactically, what is implied by a critical review and by clarity in presentation.

In the first year for the Diploma in Agriculture there are agricultural botany ; agricultural zoology, physiology and genetics ; animal nutrition ; crop pests and diseases ; soil science : the broad introductory lectures in agriculture for the first year of the Degree course are also attended but without examination. For the second year : agriculture (2 papers) ; economics of farm organisation and management ; and farm machinery, are the lecture and examination subjects. The examination also includes the Essay and a written report on a farm, or larger stretch of land (a half day being allowed for the observation the other half for writing the report). Training for this report comes from the reconnoitred walks already spoken of.

Graduates in agriculture of approved level, may enter for the Diploma on a single year of study, their examination comprising the Essay, the report, the papers, in agriculture—all as for the two-year course—and two of four subjects : agricultural botany ; soil science ; animal reproduction and genetics ; animal nutrition and growth. The candidate makes his choice of two science subjects appropriately to his inclination towards, broadly, the crops or livestock side. As graduates in agriculture, relatively to those from pure science, are less strong in the science, the course seeks to strengthen them and by a widening of outlook rather than by furtherance of detailed knowledge. In husbandry they are well founded though, in some, interest is much more in practices than in principles. Here the desirable widening should come largely from directed reading.

Lengthy experience has shown that special provision for two classes of candidate for the Diploma in Agriculture—namely, graduates in pure science and in agriculture—is well warranted.

Two different attitudes and interests—inclining respectively to the executive-advisory and the experimental—become available to the public services and in the University course, each leavens the other. Two decided difficulties may, however, have to be met with graduates in Agriculture as candidates for the Diploma in Agriculture.

Candidates from Overseas

Candidates from overseas, familiar with temperate climate farming, have no difficulty with teaching necessarily linked, though by no means limited to, the illustrations British farming affords. Those from the tropics (apart from those who have graduated in this country) are often in difficulty, the more so that many are townsmen who may have graduated in agriculture without a significant appreciation of its systems and practices in their own country. Thorough practical understanding, an aim of the course, does not come readily to them in an unfamiliar physical environment. The course can nevertheless give them a comprehension of principles in terms of primary physical, biological and economic factors, invigorated by illustrations, novel to them, under temperate conditions. Field experimentation, statistics and parts of economics and other subjects are entirely suitable and usually beneficial to these candidates. As most of them cannot learn enough in one year to succeed in the Diploma examination, the best plan is to follow selected parts of the course without official examination. In most cases, however, their sponsor-governments insist on official candidature. Graduates in pure science from overseas desiring to take the two year course of the Diploma in Agriculture are in similar difficulty. A year of preliminary training in British Agriculture not necessarily at a University, on arrival in this country would often overcome the difficulty. Central provision for this would assist all Universities receiving overseas agricultural students.

The second problem of course-adjustment for Diploma in Agriculture candidates who, being Graduates in Agriculture are accepted for the "modified", i.e. one-year course, lies in the variation among University degrees in agriculture. Some allow omission or require very limited knowledge of one or more branches of agricultural science. In some others, specialisation in one agricultural science is an option in the third year: it may result in weakness in husbandry. Such variations reflect the wholesome differences in the philosophy of agricultural teaching among Universities. Individual adjustments in teaching therefore receive much attention from the Director of Advanced Students. To this, however, the candidate's self-help must be added and it is here difficulty is sometimes met. There seem to be increasing signs, not peculiarly in agricultural study, of expecting a repleteness of formal teaching which makes reading unnecessary. Correspondingly, there may be reluctance to continue with a subject already studied through failure to appreciate the benefit of a fresh presentation and the special opportunity for wide, free, thought and reading open to those already factually informed.

For the Diploma in Agricultural Science, the objectives and main teaching features of which have already been described, there are five sections: soils, crops, livestock, statistics, and economics. In each there are beside field experimentation and simple teaching in agriculture, two agricultural sciences, or economic subjects, one prescribed, the other chosen by the candidate. For instance: in the "crop" section (for careers in plant breeding or pathology or crop physiology) agricultural botany is prescribed and with it may be taken either soil science or crop pests and diseases: as another example, for the economics section (eligibility for which requires an honours degree in economics or in mathematics) agricultural economics (of production and marketing) is prescribed and either statistics (requiring a strong foundation in mathematics) or economics of farm organisation and management is the candidate's choice. The whole course lasts one year (the candidate's fourth or fifth University year). As already pointed out, its aim is not advanced teaching in agricultural applications of one of the basic disciplines but a general induction into these applications and the creation of an informed interest in agriculture. Candidates unfamiliar with a temperate climate may be required to spend two years on this course.

Breadth and Specialisation

Specialisation and the sacrifice of breadth and balance sometimes feared from it, present in agricultural teaching a kind of difficulty not felt in pure science. This arises from the necessity of including in the course both husbandry and science. It comes up, though varyingly in each

of the three Cambridge courses. For the Degree : husbandry enlarges into the working of physical and other factors as seen in the national and in comparative agriculture ; all the agricultural sciences are included ; economics gives a foundation of history and theory to its applications in the organisation of a working unit. Teaching hours would have to be much lengthened or present treatment of some subjects severely reduced to provide for any specialisation. For two reasons prevailing opinion is opposed to both changes. This combination of subjects, in their present scope, is the result of the progressive changes already described and appears, for the present, well suited to the educative vocational teaching at which the course aims. And apart from that, specialisation in an agricultural science for those not previously brought to a high level in pure science, is still felt to be always difficult, often dangerous. There remains the possibility of specialisation in one of the several sections into which, investigationally, husbandry is becoming somewhat sharply separated, This though impracticable in the Degree course, has often been considered in relation to the Diploma.

Husbandry differs essentially in the foundations and means for advance, of knowledge, from the experimental sciences and various teaching questions arise from this. Is there in the body of husbandry knowledge and the methodology of its authentication and furthering, material and stimulus for advanced teaching in the various branches, e.g. crops, stock, grassland ? Must fundamental progress for husbandry rely not on itself but on advances in science : in cultivations, for instance, on soil physics : in livestock management on physiological study of response to environment factors and of nutritional and other influences on body tissue formation ? While awaiting these advances husbandry must empirically investigate its immediate problems. Is there in the methods and results of these investigations satisfactory material for advanced teaching : or is teaching for husbandry investigations more proper to a course in statistical analysis and its agricultural applications ? On the present Cambridge plan there is no husbandry specialisation, but in the Diploma in Agriculture statistics and methods of field experimentation (crops and livestock) have an important place. The separation of crop from animal husbandry as specialisms in post-graduate teaching is considered undesirable functionally, that is in relation to the basic conception of farming systems. Inclination to the one or the other is allowed for in choice of the Essay subject by which the candidates' private reading is orientated and also in choice of science subjects.

In train with these considerations comes the question of an Honours Degree in Agriculture. Its titular influence in training awards and appointments at home and abroad is considerable. Arguing the academic aspects, for simplicity entirely in Cambridge terms, the crux is whether teaching for the Diploma in Agriculture is at the intellectual level of the Natural Sciences Tripos. Diploma candidates must first be classed in Part I of that Tripos, this entitling them to an Honours Degree, the B.A., in which no change of title would have been made if they had devoted their further study to specialising in one pure science and taking Part II of the Natural Sciences Tripos. In the Cambridge usage the two year's work in agriculture and its sciences may be rewarded by the Diploma in Agriculture, but the title of the diplomate's degrees is still plain B.A. If titular usage were alterable, would it be academically justifiable to change Diploma in Agriculture to Honours Degree in Agriculture ? This arguable, intriguing issue is far less important than the ever present, ever evolving question of fitting into a two-year course the expanding applications of science in agriculture while also ensuring a sound comprehension of farming systems and practices, themselves in continual change.

Specialisation comes up yet a third time, with the Diploma in Agricultural Science. As explained, this offers the specialised pure scientist a broad understanding of science in agriculture and an informed interest in its practices. Specialisation in the techniques and knowledge of agricultural entomology, soil chemistry or whatever may be the chosen branch, must mainly be developed by the diplomate, working under experienced direction at the research centre or University Department in which he first gains appointment. A limited knowledge of these techniques is, in fact, imparted in the Diploma year by the candidate's contacts and association with appropriate members of the Staff and the encouragement given him to see as much as possible of their researches and to learn and practice techniques so far as time allows. Whether there should be advanced teaching courses in the several agricultural sciences has been much discussed. Students in each subject would be few, those qualified and willing to teach hard to find and the period

of formal study perhaps unhealthily prolonged. No University could provide advanced courses in all the agricultural sciences though a suitable dispersion might be arranged, some of the national Agricultural Research Institutes contributing. Potential students might be unwilling to embark on the course, even with scholarship aid, unless guaranteed appointments. Further attention should certainly be given to the question—it is not yet to everyone a demonstrable need—of advanced courses in the agricultural sciences. It might be well to start with a limited experiment. For several years, special annual demonstrations for Part II Tripos classes have been arranged by the School of Agriculture (and the Institutes formerly associated with it) on plant nematodes, virus diseases, plant breeding, soil-vegetation relationships and other matters. For plant nematodes these have now developed into a short course of lectures, with demonstrations, for any interested Diploma or Part II Tripos or research students. Other developments may commend themselves. Whether, for instance, selected aspects of agricultural science might become acceptable as part-subject options in one or more Triposes has been mooted.

The Future

Whimsical initial doubts about the introduction of Agriculture into the University soon died away and, as the Faculty steadily grew, other kinds of vocational teaching and applied research in science and in other fields were also accepted. By 1950, post-war inflation, having passed away, the University found itself enlarged in student numbers and in research activities to an extent regarded by some as incompatible with the highest academical and cultural standards and administratively manageable only by restrictive centralisation. The country's need of more and more graduates for industrial science, for commerce, and for administration was recognised by all shades of opinion. Should College and University policy nevertheless try to regulate the balance of disciplines, on what basis, by what means? Ought bounds to be set to vocational teaching and applied research? Has the loose tacit assumption that all major fields of study are desirable in every University become untenable: should the Universities aim at an orderly sharing, especially in vocational training? Is there now, in fact, virtually no University teaching which is not designedly vocational?

With these questions coming uncertainly into rational focus it is ventured to suggest that Agriculture, maintaining its present functions in the University, should aim at ensuring in its courses:

for the Degree, an educative, scientific and technical preparation for modern farming and connected occupations and arousing informed interest in agriculture at large and a feeling of responsibility for its interests,

for the Diploma in Agriculture, ample knowledge and scientific attitude in husbandry, experimental ability, and a full appreciation of scientific and technical aids,

for the Diploma in Agricultural Science, acquaintance with selected branches of agricultural science and an interest in practice, in preparation for the specialised application of the chosen pure science (already studied at advanced level) to research on agricultural problems,

and in its research, on which the vitality of its teaching depends, the lively use of its freedom in choosing and pursuing objectives, the obligation to promote agricultural progress being always in mind.

From its initial concern with British agriculture the School has been carried by its teaching responsibilities and scientific interests into agriculture at large. By this development teaching and research, in their strictly national as well as their general aspects have steadily benefited. The importance of agriculture in the national economy is one measure of the appropriateness of maintaining it in the Universities: a not less significant measure is its provocative inherent interest for the experimental sciences and for history, economics and social studies.

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AGRICULTURAL ECONOMICS

Dairy Herd Work Book. Pp. 23.
Fm Econ. Br. 1956. Price 3s. 6d. Post Free.
This has been prepared for the use of dairy farmers who wish to test the efficiency of milk production on their farms.

Rearing of Young Stock. Pp. 9.
Fm Econ. Br. Mimeogr. Rep. No. 51. 1956. Price 1s. Post Free.
This is the result of a survey of the cost of rearing dairy heifers in 72 herds. The ascertainment of the cost per heifer reared is by no means easy in practice because even when a herd is intended primarily for the production of replacements, there are purchases and sales of surplus stock. On the whole, the cost per head was estimated to amount to £77 1s. to which must be added £7 2s. as " trading loss ", giving a total of £84 3s. per heifer reared.

Report on Farming—1954/55. Pp. 44.
Fm Econ. Br. Rep. No. 43. 1956. Price 3s. 6d. Post Free.
This report gives the results of a survey of over 350 farms in the Eastern Counties of England. Unlike other areas of the country which showed a substantial fall in farm incomes, the Eastern Counties showed a fall of only 3 per cent. Cereal farms on the whole showed little change, but those carrying pigs and poultry—particularly the small farms—showed a substantial decline in profits.
Altogether, an identical sample of 320 farms showed a farm income (profit) of £852 in 1954/5 compared with £927 in 1953/4. The average size was 175 acres. It is of interest to note that the total for 1954/5 included £675 for grants and subsidies for wheat, barley, fertiliser, calves, drainage and ploughing-up grassland.
A brief survey of changes between 1944 and 1954 showed that in Eastern England the area of cash crops, particularly of cereals, has tended to increase. Indeed, in some areas, e.g. N. Essex and S. Cambs, cereals now account for two thirds of the arable land—the equivalent of four cereal crops in a six course rotation.
An account was also given of two small surveys of specialist market gardening and poultry farms. The former was carried out in Bedfordshire and covered 10 small and 5 large farms over 2 years. On the whole, farms of this kind have comparatively stable costs but receipts tend to fluctuate widely from one year to another. This is particularly true of the small holdings which carry few livestock. A group of 15 poultry holdings with an average laying flock of 700 birds showed an average farm income of £357.

1333* MACKNESS, R. A.
Beef Supplies in the United Kingdom—Retrospect and Prospect.
J. Agric. Econ. 1955, **12,** 41–63.
This paper delivered to the December, 1955 meeting of the Agricultural Economics Society, traces the course of beef supplies in the United Kingdom from the depression of the 1930s to the autumn of 1955.
The prospects of the overseas main producing countries, Argentine, Australia and New Zealand, are considered in the light of the evidence available in the autumn of 1955. Prospects of United Kingdom beef production are presented and it is suggested that home producers will have to produce what the consumer demands, at prices which will be affected by increasing quantities of imported chilled beef. Attention to cost-saving techniques will, therefore, become of increasing importance.

1316* MACKNESS, R. A.
Seasonality of Beef and Veal Supplies in the United Kingdom.
Emp. J. Exp. Agric. 1956, **24,** 20–5.
This paper examines the seasonality of home killed and imported beef and veal supplies in the United Kingdom before, during and since the 1939–1945 war until the decontrol of meat in June 1954. It is intended as an introduction to a series of papers, which will deal with the various problems posed by seasonality.
Indices of the average monthly production of home killed beef and veal in the United Kingdom for the years 1940–5, 1946–9 and 1950–3 and the increasing size of the standard deviation indicate that the pattern of production became more and more seasonal.
Indices of the average monthly imports of beef and veal for the years 1941–5, 1946–9, and 1953 and the standard deviation also show increasing seasonality.

1303* STURROCK, F. G.
How Much Equipment ?
Fm Mech. 1955, **7,** 368–70, 400–1, 452–4, 491–4.
These four articles represent an attempt to ascertain :—
(1) the capital cost of equipping a farm at different levels of mechanisation, and
(2) the capital cost of farms of different sizes.
In the first article a system was suggested for estimating the number of tractors required on a farm based on the crops and stock carried. The results were found to agree reasonably well with a survey of 56 farms.
In the second and third articles an estimate was made of the cost of equipping farms at three levels of mechanisation. Separate estimates were given for tillage implements and specialised equipment for cereals,

sugar beet, potatoes, hay and silage. To ascertain these points a survey of 60 large farms was conducted to determine the capacities of implements.

The final article dealt with the farm as a whole. Assuming a typical arable rotation of 3 cereal crops, a root crop and a one-year ley, the capital cost of new equipment per acre was estimated to range from £27·7 per acre at 100 acres down to £10·4 at 1,000 acres for stage 1 (the simplest level consistent with the use of tractors) ; from £34·9 to £12·7 at stage 2 (the level reached by most farms at the present time) and £50·2 to £15·3 at stage 3 (a more advanced level).

1284* WALLACE, D. B.
Economic Comparison of Two Farming Districts in Essex.
Agric. Progr. 1955, **29,** 10–16.

A direct comparison of profitability and the sources of revenue between the heavy clay districts of North and South Essex from 1930 to 1955. The north is predominantly corn-growing with little stock. The south concentrated on dairying off purchased concentrates until 1939 but turned to more general mixed farming under the impact of war. The reasons for this difference of cultivation are considered. Farming in the northern area was less profitable until late in the 1940s when corn prices proved more attractive than milk, especially when coupled with labour difficulties and lack of cheap imported concentrates. The final section attempts to reprice the products of both districts in the light of possible future movements. This shows that the arable area is likely to suffer more than the dairying district. Despite this, there is little likelihood of North Essex turning to increased dairying, because of the natural factors already considered. The tendency is rather towards increased corn-growing and the processing of those grains on the farm through pigs and poultry.

WALLACE, D. B.
Farm Budgeting. Pp. 117–22.
Contr. to Farm Planning and Budgeting Services in Farm Management Advisory Work. O.E.E.C. Training Course, 1954 (1955).

In the first section the paper surveys the principles involved in farm budgeting and the use of budgeting to date in this and other countries. Then various objections to budget estimates, such as uncertainty of future prices and the " average " nature of much of the data used are considered. It is suggested that these do not nullify the use of budgets when it is fully realised that budgets are used to compare two or more courses of action, and in such circumstances, errors and approximations are likely to be in the same direction in all the budgets. Therefore, the comparative advantage of one course over the others is likely to be correct. The paper concluded with a summary of the methods used in partial budgeting.

OTHER PAPERS

BRAYSHAW, G. H. **Labour-saving in the Dairy Shed.** *Suffolk Fmrs' J.* 1955, **4** (4), 15.
RIDGEON, R. F. **Where the Money Goes and What it Brings In.** *Pig Fmg.* 1956, **4** (4), 59, 61.
STURROCK, F. G. **Efficiency in the Use of Farm Labour. Pp. 82-90.** *Contr. to* **Farm Planning and Budgeting Services in Farm Management Advisory Work.** O.E.E.C. Training Course, 1954 (1955).
STURROCK, F. G. **Tests of Farm Efficiency. Pp. 34-55.** *Camb. Univ. Estate Management Club Course of Summer Lectures,* 1955. 10*s.* 6*d.*
1289* STURROCK, F. G. **Test Your Farm's Efficiency.** *Fmrs' Wkly.* 1955, **43** (17), 92-3, 95.
WALLACE, D. B. **Facts into Figures.** *Fmr & Stk-Breed.* 1955, **69** (3447), 61.
WALLACE, D. B. **Peas instead of Barley—Will it Pay ?** *Agric. Rev.* 1955, **1** (6), 36–40.

AGRICULTURE

MANSFIELD, W. S.
The University Farm, 1955.
Golden Sheaf. 1956, **9** (2), 7–10.

ANIMAL BREEDING AND GENETICS

1344* COCK, A. G.
Segregation of Hypostatic Colour Genes within Inbred Lines of Chicken.
Poult. Sci. 1956, **35,** 503–15.

Hypostatic plumage colour and pattern genes carried by inbred lines of two white breeds have been identified by examining F_1 crosses with Rhode Island Reds and New Hampshires. In White Plymouth Rocks (recessive white) segregation is occuring at the **E**-locus within 11 out of 16 lines, and at the **S**-locus (sex-linked) within 6 out of 16 lines. In White Leghorns (dominant white) 7 out of 13 lines are segregating at the **E**-locus, and 3 out of 7 at the **Bl**-locus. All lines of White Plymouth Rock are isozygous for + **Bl,** and, as far as has been ascertained all lines of both breeds are isozygous for **B** (sex-linked).

The amount of segregation occuring is greater than could reasonably be expected on a purely chance basis, as judged by an approximate test of significance. This test is subject to a number of errors, but the net effect of these is to give an under-estimate of significance. The results provide strong evidence that selection (natural and artificial) has favoured heterozygotes at the expense of homozygotes.

1337* COCK, A. G. and CLOUGH, M.
Successful Skin Homografts in Inbred Chickens.
Nature, Lond. 1956, **178,** 136–7.

Skin-grafting tests have been made on an inbred line of White Leghorn (the **I** line, **F** = 98·91 per cent). A total of 86 homografts of **I** on **I** or **I** on F_1 yielded no typical reactions, and only six homografts failed to survive, compared with seven failures among autografts on the same hosts. The ' vigour ' of the homografts was, however, on average slightly inferior to that of the autografts.

PEASE, M. S.

Another Case of Unexpected Black Chickens.

Autosex. Annu. 1955, 13–16.

The common plumage patterns in poultry, Black, Columbian, e.g. Light Sussex, and Black Red, e.g. Brown Leghorn, are usually said to be inherited as a series of multiple allelomorphs. Experiments at Cambridge have previously shown that this simple scheme does not always hold good. In the present paper another case is described which does not conform. Here a true breeding full Black line has been extracted from the cross Columbian by Black Red.

OTHER PAPERS

1306* HAMMOND, J. **Breeding Sheep for Quantity and Quality of Wool.** *Wool Knowledge.* 1955, **3** (6), 5–8.

SIMONSEN, M. & RYLE, M. **Attempts at Hybridization of Chickens and Turkeys which are Tolerant of Each Others' Antigens.** *Nature,* Lond. 1956, **177,** 437–8.

ANIMAL NUTRITION

1299* BOWLER, R. J., BRAUDE, R., CAMPBELL, R. C. *and others.*

High-copper Mineral Mixture for Fattening Pigs.

Brit. J. Nutr. 1955, **9,** 358–62.

In a co-ordinated experiment involving 182 pigs in eight centres, an addition of 250 p.p.m. copper in a mineral mixture to the diet of the pigs resulted in an improvement in the mean growth rate of the pigs.

The mean growth rate up to bacon weight of the treated animals was 1·48 lb./day, that of the untreated controls 1·40, the difference being statistically significant.

The efficiency of food conversion of the treated animals was 3·53 lb./lb. liveweight gain and that of the untreated controls 3·62. This difference was, however, statistically not significant.

1282* EVANS, R. E.

Nutrition of the Bacon Pig. XVIII.

Influence of the Dietary Penicillin on the Growth Rate, Efficiency of Food Conversion and the Nitrogen Retention of the Bacon Pig.

J. Agric. Sci. 1955, **46,** 329–61.

Before the feeding of antibiotics to pigs can be confidently recommended, more evidence is required as to their effect on growth and efficiency of food conversion. The present series of trials were designed with this object in view. The investigations were carried out by statistically designed growth trials as well as by nitrogen-balance determinations in the metabolism crates.

The main point under investigation in the first growth trial was whether the addition of penicillin to a well-balanced diet supplemented with white-fish meal would result in an increased rate of growth and efficiency of food conversion. It was concluded that, although the trend both as regards live-weight gain and efficiency of food conversion was in favour of the penicillin-fed pigs, the differences were too small to reach statistical significance. Nitrogen-balance determinations were also carried out over a period of 63 days on the white-fish meal diet with and without penicillin. The mean daily retention of nitrogen by the two hogs on the control treatment was 11·59 g., and by their two litter-mates on the penicillin treatment 11·42.

In the second growth trial penicillin was added to a diet composed of barley meal and fine bran together with a little lucerne meal and minerals and supplemented with extracted-decorticated ground-nut meal. In both the group-feeding and in the individual-feeding trial there were ten pigs receiving this basal diet and twenty pigs on the same diet supplemented with 18 mg. of procaine penicillin per lb. of meal fed. This amount of penicillin is more generous than normally used by food manufacturers. There was a striking contrast in the eagerness with which the pigs fed. The penicillin-fed pigs licked their troughs quickly and cleanly in contrast to the other pigs, and it was quite apparent that the antibiotic had a tonic effect in this respect. Although this difference diminished as the trial proceeded, it was still evident when the pigs averaged 100 lb. live weight. It was also quite obvious that the pigs receiving penicillin drank more water than the control pigs. After 10 weeks on experiment the forty pigs receiving penicillin averaged 87·5 lb. in live weight as compared with a mean of 81·7 lb. for the twenty pigs on the control diet. This compares with mean live weights of 186·6 lb. (penicillin) and 177·9 lb. (control) over the whole 20 weeks that the trial lasted. The differences for the group-fed pigs were too small to reach statistical significance, owing to the wider variations within the groups. Highly significant differences, in the period from 36 to 90 lb. live weight, were obtained with the individually fed pigs. The mean live weight increase per day was 0·95 lb. on the penicillin treatment as compared with 0·88 lb. on the control diet. Correspondingly significant differences characterised the figures for efficiency of food conversion over this period, the mean requirements being 29·7 lb. on the penicillin treatment and 3·21 lb. on the control diet. In the period from 90 to 200 lb. live weight the differences observed were very small and not statistically significant. Over the whole period from 36 to 190 lb. live weight the control pigs required on an average 5·3 more days and consumed approximately 19 lb. more meal per pig, an increase of 3·4 %.

The same diet, supplemented with extracted-decorticated ground-nut meal, was used in the second nitrogen-balance trial. The addition of penicillin failed to bring about any significant improvement in the retention of nitrogen or in the utilisation of the dietary protein.

The effect of adding penicillin alone and also in conjunction with a vitamin B_{12} supplement (Dista-feed), to the diet supplemented with extracted-decorticated ground-nut meal, was investigated in the third growth trial. The penicillin-fed pigs were better feeders from the start than the control pigs, but in this trial the Dista-feed seemed to have an adverse effect on palatability. From a common initial live weight of 40 lb. for each pig up to 90 lb. live weight, the pigs on the control treatment required on an average 3.6 days longer and consumed 10·54 lb. more meal than the pigs receiving procaine penicillin The live-weight increase per day averaged

0·92 lb. on the control diet in compariosn with 0·98 lb. on the penicillin treatment. The figures for efficiency of food conversion were also in favour of the penicillin-fed pigs, being 3.05 and 3·25 lb. respectively. To increase 155 lb. in live weight the penicillin-fed pigs required on an average 4 days less with a saving of about 13 lb. of meal per pig, in comparison with the control pigs. The improvement was entirely confined to the period immediately after weaning. No improvement resulted from the simultaneous addition of vitamin B_{12} with the antibiotic.

The nitrogen retention of pigs was also investigated with and without penicillin and vitamin B_{12}, using diets supplemented with extracted-decorticated ground-nut meal and extracted soya-bean meal. A summary is given of the results of nitrogen-balance studies with twenty pigs to investigate the effect of antibiotics on protein metabolism.

It was concluded from the above trials that the main effect of procaine penicillin was to stimulate the appetite of the pigs on all-vegetable diets. It seemed therefore that unless the pigs were allowed to benefit fully from their improved appetites, by being allowed full-feed, the maximum effect from the feeding of penicillin would not be attained. In the fourth growth trial this point was tested, using the group-feeding lay-out and adjusting the ration daily so that food was available almost continuously. With the individually fed pigs in this trial the opportunity was taken to test the statement that magnitude of the response to the feeding of antibiotics is greater with diets supplemented with soya-bean meal than with other vegetable-protein concentrates.

The group-fed pigs under conditions approaching *ad lib.* feeding were able to consume without wastage distinctly higher amounts of meal than we usually feed in these growth trials, when the meal is restricted according to the feeding chart. The pigs receiving penicillin displayed at first better appetites than the control pigs, and made correspondingly better live-weight gains, but as the trial proceeded the appetite of the control pigs gradually improved and eventually surpassed that of the penicillin-fed pigs. It seemed as if the latter had been overeating in the initial period and were suffering from surfeit. After 11 weeks on experiment the mean live-weight of the control pigs was slightly higher than that of the group that received penicillin. It is also interesting to note that with *ad lib.* feeding, no outstanding difference in water consumption was observed between the treatments, the water consumption being mainly influenced by food consumption.

The results for the individually fed pigs in the fourth growth trial showed that the effect of adding penicillin to a cereal diet supplemented with extracted soya-bean meal was even less pronounced than with extracted-decorticated ground-nut meal. No significant effect was shown, even in the period immediately after weaning, on the rate of gain or on the efficiency of food conversion as a result of adding 18 mg. of procaine penicillin per lb. of meal. In this trial the pigs were exceptionally good feeders and the soya-bean meal diet proved to be highly palatable.

It may be concluded from the results of these trials that with healthy pigs and using normally balanced palatable rations, the improvement in the rate of growth, efficiency of food conversion and rate of nitrogen retention to be expected from the inclusion of penicillin in the diet is generally too small to make it economically worth while.

1318* Evans, R. E. & Maguire, M. F.

Influence of Dietary Antibiotics on the Activity of the Cellulose-splitting Bacteria in the Intestine of the Bacon Pig.

J. Agric. Sci. 1956, **47,** 344–9.

The present investigation is concerned with the influence of procaine penicillin and aureomycin on digestion. In particular, the effect of antibiotics, in amounts generally included in feeding-stuffs, on the bacterial digestion of cellulose in the large intestine of the pig, was investigated.

The digestibility of a basal diet composed of fine bran, maize meal, dried lucerne meal and white-fish meal was determined with and without the addition of antibiotic. No effect was noted on the digestibility of any food constituent.

The diet fed in four digestion trials contained 500 g. of shredded fodder cellulose. The digestion coefficient for the crude fibre, in these diets rich in cellulose, was 76·2% when 18 mg. of procaine penicillin was added per lb. of meal and 76·8% when no antibiotic was added.

The nitrogen-free extractives in the fodder cellulose are mainly if not entirely composed of xylan. If the nitrogen-free extractives and crude fibre are combined to give ' cellulose ' as defined by Norman & Jenkins, the digestion coefficients for the cellulose were 85·7, 83·4, 85·7 and 87·2%, respectively, thus showing little difference between treatments.

There is no warrant for assuming that the antibiotics had any bacterial or bacteriostatic effect on the cellulose-splitting organisms.

Evered, D. F.†

Excretion of Amino Acids by the Human. A Quantitative Study with Ion-exchange Chromatography.

Biochem. J. 1956, **62,** 416–27.

By ion exchange chromotography daily excretions of amino acids and midday plasma levels were determined for a number of healthy adults and for patients with amino aciduria.

The normal subjects and each of the patients studied showed distinctive patterns of amino acid excretion, patients with the same syndrome showing characteristic similar patterns. In phenylketonuria a high phenylalanine output and a raised plasma level were found with a normal clearance. This suggests an overflow mechanism due only to the renal threshold of this substance being exceeded.

† Work carried out at University College Hospital Medical School, London.

Conversely, low or normal plasma levels were found with the amino acidurias observed in the adult form of the Fanconi syndrome, the Hartnup syndrome and β-amino*iso*butyric aciduria. This suggests defective renal tubular reabsorption of specific amino acids consistent with previous views based on paper chromatography. The approximate plasma clearance of certain amino acids were of the order to be expected of the glomerular filtration rate.

The ion-exchange method also proved convenient for the quantitative determination of β-amino*iso*butyric acid. Assays on specimens from 24 healthy subjects gave results compatible with published genetical researches using paper chromatography.

ANIMAL PATHOLOGY

1319* Betts, A. O. & Campbell, R. C.

Action of Antibiotics and Sulphamezathine on the Causal Agent of Virus Pneumonia.

J. Comp. Path. 1956, **66,** 89–101.

The effects of sulphamezathine, penicillin, streptomycin, chloromycetin, chlortetracycline, oxytetracycline and tetracycline on the causal agent of virus pneumonia of pigs were tested. It was found that infection could be prevented with chlortetracycline and oxytetracycline, but that neither of these antibiotics nor the other drugs tested had any effect upon established lesions. Streptomycin appeared to have some slight protective action.

ANIMAL PHYSIOLOGY AND PRODUCTION

1324* Averill, R. L. W.

Fertility of the Ewe.

Proc. Soc. Stud. Fertil. 1955, **7,** 139–48.

131 mature ewes were allowed to mate normally with proven fertile rams throughout the 1953/4 breeding season and were killed at either 3 days or 18–24 days after mating. Post-mortem examination of the genitalia provided information on within-season changes in ovulation rate, fertilisation rate, conception rate and on ovum and embryonic death rates. The results obtained are discussed in the light of the existing knowledge of the physiology of reproduction in the sheep.

1325* Averill, R. L. W.

The Use of Oestrogens in Fat Lamb Production.

Proc. Brit. Soc. Anim. Prod. 1955, 18–29.

Oestrogen implants caused slight but insignificant gains in weight over periods from 51 to 140 days in suckling lambs of 27 to 30 lb. initial liveweight.

Carcass fat was reduced but carcass conformation was apparently unaltered as a result of the treatment.

The rate of absorption from the implanted oestrogen tablets was apparently affected by the dose level, the efficiency of implanting into the subcutaneous site, and by an obscure individual effect on the part of certain lambs.

Death associated with rectal and vaginal prolapse occurred as a result of oestrogen treatment in four treated lambs.

Implantation of oestrogenic substances alone was found to be of no commercial value when practised on fast-growing suckling lambs under pastoral conditions.

1311* Gordon, I.

Hormonal Augmentation of Fertility in Sheep.

Proc. Brit. Soc. Anim. Prod. 1955, 55–63.

Over two breeding seasons (1952–4), field trials, involving a total of 594 treated and control ewes of the Romney, Cheviot and Southdown breeds, were conducted in an attempt to increase flock fertility by P.M.S. hormone. It was found that treatment led to a general increase in fertility. The results from trials are discussed in relation to the possible practical utility of this form of treatment under British conditions.

1294* Hammond, J.

Beef Production.

J. Fmrs' Cl. 1955 (8), 123–35.

The general situation concerning beef supplies is outlined and comparison is made between the production of beef and other animal products. A short historical account is given of beef production in the U.K. An outline of recent developments in the breeding of beef cattle, particularly the use of colour-marking beef bulls by A.I. on dairy herds, is given. The importance of rearing the calf on a high plane of nutrition, by multiple suckling or otherwise, is stressed, while cutting out the store period is recommended both on quality and economic grounds. The cheapest method of production is finishing on grass, but this leads to seasonal production ; methods for flattening the autumn peak are suggested.

1336* Hammond, J.

Factors Enhancing Fertility.

Adv. Sci. 1956, **12,** 508–10.

Part of a symposium on Fertility in Farm Animals. Methods for enhancing fertility are required not only for lowering costs of production but also for speeding up genetic improvement. Artificial insemination has been most effective for the latter purpose ; with cattle the deep-freeze method offers further possibilities. A new

dilutor, glycine, and new methods are likely to make A.I. a practical possibility for proven boars. With the female, increase in the numbers of eggs shed can be induced by flushing in sheep and injection of P.M.S. some four days before heat in cattle and sheep, but breeding for high fertility should be the ultimate aim. Different breeds of sheep vary in respect to the speed with which they react to decreasing daylight hours by exhibiting oestrus, but all breeds respond to injections of P.M.S. after progesterone ; the production of two crops of lambs a year is therefore possible. The problem of increasing the fertility of cows of high genetic worth, by superovulating and transplanting the fertilised eggs awaits the discovery of a simple method of transplanting ova in the cow. With small animals the shortening of the generation interval has been made by ovulating the female before puberty by means of injecting P.M.S. and transplanting the fertilised ova in adults. Fertilised eggs have been obtained from calves under a month old.

1305* HAMMOND, J.

Hormones in Fertility.

N.A.A.S. Quart. Rev. 1955 (30), 227–31.

A short account is given of the anterior pituitary hormones (and substitutes for them) which affect the number of ova shed. By injections of suitable doses of Pregnant Mare Serum hormone (P.M.S.) it is possible to produce twins in cattle and increase the lambing percentage in sheep. It is also possible to breed sheep out of season by giving injections of progesterone before P.M.S., but further experiments are required with suckling ewes. Using injections of P.M.S. to produce a large number of ova is a preliminary to transplanting fertilised eggs. While this has been done in rabbits and sheep it requires an operation and to become a practical proposition in cattle a simple method of inserting the egg is required.

1309* HAMMOND, J., JR.

The Rabbit Corpus Luteum : Oestrogen Prolongation and the Accompanying Changes in the Genitalia.

Acta Endocr. 1956, **21,** 307–20.

Tablet implants were used to treat adult female rabbits with progesterone, testosterone and with oestrogen in the presence and absence of corpora lutea. The higher oestrogen dosages used caused severe uterine damage in the presence of corpora lutea, but it was possible to maintain corpora lutea for long periods by lower levels of oestrogen which did not cause marked damage. When the corpora lutea were maintained the mammary gland remained in the early pregnant condition up to 29 days after ovulation, but not indefinitely.

The oestrogen level necessary to maintain corpora lutea is below that required, in the presence of corpora lutea, to cause uterine and vaginal growth comparable to that in late pregnancy. From the relative weight of uterus and vagina in the treated animals with corpora lutea, it appears unlikely that the growth of these two organs in pregnancy can be explained solely in terms of placental oestrogen and luteal secretion maintained by the oestrogen.

1322* JOUBERT, D. M.

An Analysis of Factors Influencing Post-natal Growth and Development of the Muscle Fibre.

J. Agric. Sci. 1956, **47,** 59–102.

The effect of species on muscle fibre diameter was examined by comparing fibres of m. gastrocnemius of the rabbit, the pig, the sheep and cattle at birth and maturity. Only male animals were included in the comparison. No relation exists between muscle fibre size and body size at either age. At birth the rabbit and sheep had rather similar-sized fibres, while those of the pig and cattle were respectively smaller and larger in diameter. At maturity the pig had the largest fibres, followed in decreasing order by the rabbit, cattle and sheep. The size of muscle fibres at maturity was accounted for by the degree of post-natal development in body weight of the particular species.

The effect of breed was studied on two groups of steers, the one consisting of Dairy Shorthorns and Dairy Shorthorn-crosses,and the other of Friesians and Friesian-crosses. Samples were available from m. longissimus dorsi for each of thirty-four animals : 100 fibres were measured per sample. The Friesians and their crosses had significantly thicker muscle fibres than the pure- and cross-bred Dairy Shorthorn steers. The largest differences existed between the respective pure-bred animals ; differences between Friesian × Angus and Dairy Shorthorn × Angus, and Friesian × Hereford and Dairy Shorthorn × Hereford, though fairly distinct, were, however, not statistically significant.

The effect of age was investigated on a group of forty-one lambs of different nutritional status and sex, and ranging in age from birth to 290 days. Muscle fibre diameter was shown to increase in general with age, while a consistent decline in the coefficient of variation was regarded as indicative of the fact that muscular growth during post-natal life occurs essentially by hypertrophy of individual fibres, there being no increase in the number of fibres after birth.

Correlating changes in muscle fibre diameter with corresponding changes in weight, indicated that muscular growth is primarily a function of physiological age, and not strictly one of chronological age. Though highly significant correlations were established between mean fibre diameter and body and carcass weights, the strongest correlation was shown to exist between the former variate and muscle weight. However, a correlation of an even higher order was obtained between the square of muscle fibre diameter and muscle weight.

The relationships were confirmed by an analysis of twenty lambs of the same breed, all slaughtered at 112 days of age ; the heavier lambs had larger fibres than their lighter counterparts, very nearly proportional to differences in weight of muscle.

Sex differences in muscle fibre diameter could very nearly be accounted for on a basis of muscle weight alone at birth and at a carcass weight of 13·6 kg. At 290 days of age, high-plane wethers had but slightly thicker

fibres than their female counterparts, despite a significantly heavier musculature. This was ascribed to differences in length of muscle (as shown by bone measurements), and also to differences in compositon of the muscle. The results of chemical analyses were presented to prove that the muscles of wethers at that age contain greater amounts of intra-muscular (chemical) fat, hence the apparent increases in the weight of muscle could not be accounted for by an increase in the diameter of component fibres.

The effect of nutrition was studied in both lambs and mature ewes and shown to influence muscle fibre diameter appreciably at all ages. However, at birth the differences, though in favour of the high-plane lambs, were not significant statistically, probably due to small numbers in the respective groups. Muscle fibre diameter of mature ewes on a supermaintenance diet increased in proportion to increases in total muscle, while on a submaintenance diet the opposite effect was found.

The effect of the individual muscle was studied by comparing absolute and relative development of fibres m. longissimus dorsi, m. rectus femoris and m. gastrocnemius. At birth m. gastrocnemius possessed the largest fibres and m. longissimus dorsi the smallest. On the whole, fibres of m. longissimus dorsi, the muscle being situated in a late maturing part of the body, showed greatest relative increases during post-natal life, while those of m. gastrocnemius, an earlier maturing muscle, increased latest. Comparing the relative degree to which different muscles develop under high and low planes of nutrition, muscle fibre measurements indicated that the low-plane animals at a chronological age of 290 days, resembled their 60-day-old high-plane counterparts in anatomical development.

From width and depth measurements on m. longissimus dorsi (or ' eye muscles ') recorded at the junction of the thoraic and lumbar vertebrae, it was shown that width is the earlier maturing dimension and less affected by nutritional factors than depth. Though significant relationships were found between mean fibre diameter and both muscle width and depth, the latter dimension was the more strongly correlated with changes in thickness of fibres.

Work of this nature might provide a suitable basis for estimating the amount of muscular tissue in a carcass.

It is obvious, however, that factors such as species, breed, and possibly sex, would have to be considered in an attempt to establish a relationship of this kind. A late maturing muscle probably would furnish the most reliable criterion ; in the light of evidence produced by this study, m. longissimus dorsi sampled at the junction of the lumbar and thoracic regions has been suggested as most suitable.

1352* Joubert, D. M.

Relation Between Body Size and Muscle Fibre Diameter in the Newborn Lamb.

J. Agric. Sci. 1956, **47,** 449–55.

An investigation is reported in which the relationship was examined between body size and muscle fibre of nineteen newborn lambs and included twelve males and seven females. Body size was measured in terms of the dead body weight and that of the dressed carcass, while muscle fibre size was estimated on the basis of the mean cross-diameter of 150 fibres per lamb.

It was shown that the dressing (or carcass) percentage tends to increase with an increase in body weight, from 42·26% at a body weight of 2,000g. to 49·04% at 7,000g.

Of the 2,850 cross-diameters recorded, the majority (33.8%) of the fibres measured between 8.0 and 9·6μ, while individual fibres varied in size from 1·6 to 22·4μ.

Highly significant, positive correlations were shown to exist between both body ($\mathbf{r}$ = 0·996) and carcass ($\mathbf{r}$ = 0·946) weight, and mean muscle fibre diameter, indicating that difference in size between the lambs may be accounted for largely by corresponding variations in the size of individual muscle fibres.

Of the three muscles sampled m. gastrocnemius had the largest mean fibre diameter (10.38μ), followed in decreasing order by m. rectus femoris (9.72μ) and m. longissimus dorsi (9.09μ). These inter-muscle differences were significant at the 1% level of probability.

Ram lambs had significantly thicker muscle fibres (10.32μ) than ewe lambs (8.72μ), but also weighed the heavier and produced heavier dressed carcasses. Some evidence was produced, however, in support of the theory that at comparable weights males possess thinner individual, and therefore a greater number of fibres than females.

1351* Joubert, D. M.

A Study of Pre-natal Growth and Development in the Sheep.

J. Agric. Sci. 1956, **47,** 382–428.

The growth and development of forty single male sheep foetuses was examined. In order to age the material, data were collected from the literature on foetal weights and crown-rump lengths of specimens of known age.

Of the foetal measurements recorded, head length and, particularly, head width were shown to be earlier maturing than chest circumference and chest depth, while crown-rump length made even greater proportional increases during pre-natal life.

The head decreases in relative size throughout foetal life. Head : body ratio, however was found to be unsuitable as a criterion of pre-natal age, since foetuses of equal age may differ appreciably in this respect.

Dissections of the major constituent parts of the foetal body indicated the skinned head to be the earliest maturing, followed in order by the organs (weighed *en masse*), dressed carcass, total skin and, finally, the skinned feet and tail, which were the latest maturing.

In contrast to the direction of retardation of growth during post-natal life, in the foetus the gradient followed a proximo-distal direction ; scapula and pelvis, for example being earlier maturing than metacarpus and metatarsus. Linear development of individual bones was earlier maturing than growth in weight.

In weight, m. longissimus dorsi appeared to be earlier maturing than m. rectus femoris and m. gastrocnemius lateralis ; these three muscles develop at much the same rate in respect of length and depth during pre-natal life, but m. longissimus dorsi showed relatively less development in width. The cross-diameter of fifty individual fibres was measured by means of an ocular micrometer, A tendency was observed for fibres of m. longissimus dorsi to be earlier maturing than those of m. rectus femoris or m. gastrocnemius.

Whereas muscle-fibre diameter increased but slightly (approximately 19·5%) during the first two-thirds of pre-natal life, the increase thereafter was substantial ; the increase amounted to 113·2% from about 108 days to full-term. The data thus appears to support the accepted view that muscular growth occurs initially by an increase in the number of fibres, and in late foetal life primarily by hypertrophy.

The dispersion of muscle fibre sizes, in absolute measure, was shown to increase with advancing foetal age, the range at birth being considerable.

Measurement of fibres from muscles situated in different anatomical regions of the body indicated that the muscles of the head were earlier maturing than those of the trunk, and muscles of the thoracic limb earlier maturing than those of the pelvic limb.

MARSHALL, F. H. A.
Marshall's Physiology of Reproduction.
Ed. by A. S. PARKES, Vol. 1, Part 1. 3rd ed. Pp. xx + 688. Longmans, 1956. Price £7 10s.

1312* PERRY, J. S. & POMEROY, R. W.
Abnormalities of the Reproductive Tract of the Sow.
J. Agric. Sci. 1956, **47**, 238–48.

863 female pigs, mostly sows discarded from commercial herds in East Anglia, and sold for slaughter, were examined when killed and the condition of the reproductive tract was related to the animal's reproductive history when it was known.

Anatomical abnormalities of the reproductive organs, other than cystic ovaries, were found in sixteen animals (including two gilts) and the abnormality involved the ovary in eight of them. At least two of them were brought to notice because of the abnormalities so that the number seen affords a maximal estimate of the incidence of this type of aberration in the pig population from which the sample was drawn.

A wide variety of ovarian cysts was found, often within a single pair of ovaries. It is suggested that all the ' types ' of cyst described here and elsewhere are different degrees of the same kind of aberration, the morphological form being determined by the stage in the ovulation process reached by the follicle (or corpus luteum) when overtaken by the physiological breakdown responsible for the cystic distension.

As none but slight degrees of cystic abnormality were found in pregnant animals, these were used as a criterion to distinguish between slight and severe degrees of cystic abnormality, the latter in all probability associated with sterility, and encountered in about 10% of the sows in the sample.

Slight degrees of cystic abnormality do not appear to be associated with the production of small litters ; pregnancy appears to be either unaffected or else precluded altogether.

The reproductive organs of more than half of the sows which were discarded for reproductive failure were found to be normal, and in many cases the failure could only be attributed to chance. A large proportion of the sows discarded as sterile were culled after their first litter. The preponderance of reproductive failure at this stage could not be attributed to ovarian cysts.

There was a marked seasonal variation in the incidence of ovarian cysts, the proportion of animals with some degree of cystic abnormality being twice as high in the spring months as in the autumn. The variation is thought not to be due to sampling errors alone. There was no seasonal variation in the average number of corpora lutea or of embryos.

The observations are discussed in relation to work of a comparable nature done elsewhere, particularly in U.S.A. Some striking divergences are apparent. Large cysts, commonly found in pregnant animals in America, did not appear to interfere with gestation and were evidently formed during pregnancy. Such cysts were never observed in pregnant animals in the English material, where only nine out of 130 pregnant animals showed any degree at all of cystic abnormality, by no means severe in any of them, and not involving ' large ' cysts. Marked enlargement of the clitoris was found to be associated with one type of ovarian cyst in America but was not observed in England. A greater diversity of cystic abnormality was recognised in the present work than in American studies, and such histological and endocrinological work as has so far been done has given results somewhat different from those recorded in America.

There is strong evidence that oestrus may fail to occur in the sow, so that the animal cannot be served. The condition is probably reported more frequently than it occurs, however, since reliance is often placed on examination alone for the detection of heat, without using a boar.

There is some evidence that oestrus and ovulation may get out of step in some animals and it is possible that the cause is related to that of ovarian cysts. Oestrus and service may occur during pregnancy.

1323* POMEROY, R. W.
Consumer Preference for Beef.
Inst. Meat Bull. 1956, **14**, 3–9.

An enquiry into consumer preference for beef yielded the following results:—

(*a*) 61·6% of consumers preferred the best quality beef even though it was slightly overfinished.
(*b*) Second and subsequent choices indicated a general bias against fat.
(*c*) 4·1% of consumers showed a definite preference for fat and 5·8% a definite aversion to fat.

(*d*) Farmers preferred a rather fatter selection of beef than other consumers and butchers were the least fat tolerant.
(*e*) The bias against fat was most marked in the younger age groups.
(*f*) There were marked regional variations in fat tolerance, consumers from Wales, the North West and West Midlands and the South being less tolerant than the Great Britain average, while consumers from the East, North East, East Midlands and the West were more tolerant.
(*g*) The order of preference is affected by the number of children in the family and fat tolerance decreased with increasing size of family.

1347* Roy, A.
Storage of Boar and Stallion Spermatozoa in Glycine-egg-yolk Medium.
Vet. Rec. 1955, **67,** 330–1.

Hitherto the use of buffers containing ionisable salts in dilutors for boar and stallion semen has not been very successful in keeping the sperm alive outside the body. Boar semen diluted with 3% glycine-egg-yolk stored at 4°C kept the sperm motile for a longer period than citrate-egg-yolk dilutor. Centrifuged sperm diluted with 4·5% glycine-egg-yolk maintained motility for 48 hours at 4°C ; when glycerol was added to this motility was maintained for 3 days. Stallion semen when diluted with an equal volume of 4% glycine-egg-yolk and kept at 4°C, displayed nearly full motility for 48 hours. Samples diluted in this way plus the addition of glycerol were cooled to –79°C and 60–70% of the originally active sperm was motile when thawed after 24 hours.

OTHER PAPERS

1307* GORDON, I. **Controlling Sheep Fertility by Hormonal Therapy.** *Agric. Rev., Lond.* 1956, **1** (12), 24–8.
1292* HAMMOND, J. **Anatomy of Meat Animals.** *Inst.Meat Bull.* 1955 (12), 15-21.
1335* HAMMOND, J. **Artificial Insemination.** *Agric. Rev.* 1955, **1** (7), 22–8.
HAMMOND, J. **Beef Production in Great Britain.** *Inst. Meat Bull.* 1956 (14), 32–5.
1295* HAMMOND, J. **How the Show has Helped the Meat Industry.** *Meat Marketing.* 1955, **28** (29), 28–9.
1293* HAMMOND, J. **The Right Pig.** *Agriculture, Lond.* 1955, **62,** 365–8.
1298* HARRINGTON, G. & POMEROY, R. W. **Systems of Marking Bacon Competitions.** *Pig Breed. Gaz.* 1956 (84), 36–8.
POMEROY, R. W. **Advantages of Progeny Testing.** *Pig Breed. Gaz.* 1956 (85), 28–30.

CROP HUSBANDRY

1283* Barker, M. G., Hanley, F. & Ridgman, W. J.
Studies on Lucerne and Lucerne-Grass Leys. I.
J. Agric. Sci. 1955, **46,** 362-76.

Some earlier work concerning the management of lucerne is discussed.

Two experiments, designed to compare cutting and grazing the second (July) crop, and cutting and grazing the third crop at two different dates (September and October) each year on the yield and botanical composition of a lucerne-grass (mainly cocksfoot) ley, are described and the results discussed.

The method of defoliating both the second and the third crops had very little lasting effect on yield or composition of the ley, though some temporary effects, depending on season, were found.

It is shown that date of defoliating the third (autumn) crop of a lucerne-grass mixture may influence the yield of oven-dried produce from an individual crop. Late autumn defoliation led to a greater yield of lucerne and a greater proportion of lucerne in the produce, but since the opposite effect was found in the yield of grass there was no overall effect on the total yield of oven-dried produce over a 3-year period.

In these experiments it appeared that lack of winter cover had no adverse effect on the productivity or persistence of lucerne in the lucerne-grass mixture studied.

1290* Ridgman, W. J., Hanley, F. & Barker, M. G.
Studies on Lucerne and Lucerne-Grass Leys. II. Nitrogenous Manuring of a Lucerne-Cocksfoot Ley.
J. Agric. Sci. 1955, **46,** 441–8.

An experiment, carried out to determine the effect of dressings of sulphate of ammonia on an established lucerne-cocksfoot ley grown in narrow rows on heavy gault clay soil, is described and the results discussed. The experiment was carried out over 3 full years (1948–50) and the first crop of the following year. The results suggest that it is possible to increase the yields of grass and total produce without decreasing the yield of lucerne but that no marked increase in the yield of nitrogen per acre is to be expected. Of the times of application tested, February proved the most effective.

1301* Ridgman, W. J., Hanley, F. & Barker, M. G.
Studies on Lucerne and Lucerne-Grass Leys. III. Effect of Variety of Lucerne and Strain of Grass.
J. Agric. Sci. 1956, **47,** 50–8.

An experiment comparing the growth and productivity of six varieties of lucerne representing a wide diversity of ecological conditions grown in association with S 37 Cocksfoot, S 143 Cocksfoot and a commercial cocksfoot/timothy mixture is described and the results discussed.

Variety of lucerne had a marked effect on establishment, persistence, recovery from defoliation, early spring growth, yield of total dried produce, proportion of lucerne in that produce and on yield of nitrogen.

There was no evidence of differing degrees of compatibility of varieties of lucerne with the three strains of grass used.

OTHER PAPERS

RIDGMAN, W. J. **Some Recent Crop Husbandry Experiments on the University Farm.** *Golden Sheaf.* 1956, **9** (2), 35–8.

1330* Dunning, R. A.

Mangold Fly Attacks in 1955. Use of Metasystox in their Control.

Brit. Sug. Beet Rev. 1956, **24,** 121–4, 127–8.

During 1955 the first generation attack by mangold fly (*Pegomyia betae* Curt.) on seedling beet was particularly widespread and severe. Data is given on the acreage of beet attacked, distribution of attacks, acreage sprayed and the insecticides used. A trial was carried out to compare the relative effectiveness of Metasystox and D.D.T. for the control of mangold fly and black aphis (*A. fabae*), and recommendations are made for the cultural and chemical control of first and second generation mangold fly attacks.

Geering, A.†

A Method for Controlled Breeding of Cotton Stainers *Dysdercus* spp. (*Pyrrhocoridae.*)

Bull. Ent. Res. 1956, **46,** 743–6.

A description is given of the method used for the large-scale breeding of cotton stainers (*Dysdercus* spp.) at the Cotton Research Station in Uganda. The method entails the use of a standard cage unit, consisting of a shallow tin cylinder with detachable cloth top and bottom. The advantages of this type of unit are outlined, with particular reference to control of disease and to the other hazards of large-scale breeding.

1296* Jones, F. G. W.

A Microplot Technique for the Study of Soil Populations of Cyst-forming Root Eelworms of the Genus *Heterodera.*

Contr. to Soil Zoology. Ed. by D. K. McE. Kevan. Pp. 390–3. (Butterworths Sci. Publ., London, 1955. 55s.).

1296* Jones, F. G. W.

Quantitative Methods for the Estimation of Cyst-forming Nematodes (*Heterodera* spp.) in Soil.

Contr. to Soil Zoology. Ed. by D. K. McE. Kevan. Pp. 394–402. (Butterworths Sci. Publ., London, 1955. 55s.).

Cyst-forming species of *Heterodera* are important pests in many countries. Water flotation methods of extraction of cysts form the basis of all population estimates. In practice, the error variance generally exceeds the expected Poisson variance in such estimates because of imperfections in technique. For research purposes it is desirable to work with cyst-counts of 100 or more and to vary the sample size accordingly rather than to work with samples of fixed size. For field research the use of ' microplots' is advocated. The difficulties of estimating the viability of the cysts found are reviewed and reference is made to recent work using root exudates which stimulate hatching in order to estimate the viability of eelworm cyst populations.

1308* Jones, F. G. W.

Soil Populations of Beet Eelworm (*Heterodera Schachtii* Schm.) in Relation to Cropping. II. Microplot and Field Plot Results.

Ann. Appl. Biol. 1956, **44,** 25–56.

Experiments on specially constructed microplots were undertaken to overcome some of the difficulties associated with population studies using field-plots. In these microplots Cruciferae caused greater increases in beet-eelworm populations than Chenopodiaceae when the initial population was low and greater decreases when it was high. Non-hosts and inefficient hosts caused reductions of the same order as host plants in the same families.

When sugar beet was grown at varying initial populations, the final population tended to rise to a 'ceiling ' which varied with soil and season. The ' ceiling ' effect is also observed in the field and in pot tests, and may be used as a measure of the efficiency of different host plants or, if the same host plant is grown, as a measure of the effect of different soils and seasons. A linear relationship exists between the logarithm of the initial eelworm population and the yield of roots and tops.

Eelworm attack upon sugar beet renders the plants incapable of profiting from favourable growing conditions and reduces the size of the plants without affecting the sugar content of the roots. Within certain limits, the final eelworm population is independent of yield or plant density. Cruciferae are far less susceptible to injury by root invasion than the cultivated varieties of *Beta vulgaris.*

It is suggested that host efficiency in raising and supporting eelworm populations and susceptibility to injury are distinct and independent attributes of host plants. Decay of populations in land under fallow or non-host crops in non-host families is approximately 20, 40 and 50% per annum for cysts, cysts with contents, and eggs respectively, and appears to be largely independent of initial population level. The average egg content of cysts with contents falls from 177 eggs/cyst in the first winter after the cultivation of a host crop to 131, 118 and 114 in the second, third and fourth respectively. The *in vitro* hatch from beet-eelworm cysts is affected by previous cropping. Low hatches are sometimes obtained in the winter and spring after the cultivation of host crops, especially where there has been considerable increase. A period of maturation appears to be necessary before eggs are fully sensitive to hatching stimuli.

The implications of the microplot results are briefly discussed. Population increase appears to be limited by intraspecific competition rather than by specific enemies. The development and decline of infestations follows a course similar to that in other pests but, because of lack of mobility, the time factor is greatly extended. The differential effects of soil, season and host crop render set rotations ineffective as a measure of control once land has become generally infested. At this stage a system of advice based on soil sampling is desirable.

† Work carried out at the Empire Cotton Growing Corp., Cotton Research Station, Uganda.

1334* Lowings, P. H.†

The Fungal Contamination of Kentish Strawberry Fruits in 1955.

Appl. Microbiol. 1956, **4,** 84–88.

The presence of fragments of fungal hyphae, determined by the Howard mould count technique, is often taken to indicate the extent of rotting in the fruit from which soft fruit products have been manufactured. A high mould count may limit the acceptability of such products in certain oversea markets.

In fresh strawberry fruits harvested in mid-Kent during 1955, the most common hyphae were generally those of *Sphaerotheca humuli* which, together with *Botrytis cinerea* and *Mucor piriformis,* contributed 98 to 99·5 % of the total hyphae in both fresh and stored fruit. *Cladosporium herbarum, Penicillium* spp., and *Trichoderma viride* were almost ubiquitous on the senescent styles and stigmas adhering to the fruit, but contributed little to the mould counts. Only *B. cinerea* and *M. Piriformis* were found to cause significant rotting. A yeast, *Kloeckera apiculata,* was found to be very prevalent, and caused slow breakdown when inoculated into sterile, wounded fruits. The significance of information obtained by the Howard mould count technique is discussed in the light of these results.

A small scale investigation of substances suitable for application to harvested strawberries, showed peracetic acid to be a promising agent for the control of mould development during short periods of storage.

1346* Shepherd, A. M.

A Short Survey of Danish Nematophagous Fungi.

Friesia. 1956, **5,** 397–409.

An illustrated account is given of the species of nematophagous fungi recorded in Denmark, with a short discussion on the type of habitat and substratum from which the various species were recorded.

1314* Wallace, H. R.

Effects of Soil Structure on the Emergence of Larvae from Cysts of the Beet Eelworm.

Nematologica. 1956, **1,** 145–6.

The importance of the influence of soil aeration on the emergence of larvae from cysts is briefly discussed. Experimental results suggest that soil aeration is the most important single factor associated with soil structure which influences larval emergence. Pore size and moisture content in the soil are intimately related and their influence on larval emergence is really an expression of their effect on soil aeration. Competition for available oxygen between eelworms and micro-organisms in the soil may also affect the rate of larval emergence. In comparing the activities of eelworms on different soil types, it is suggested that more attention should be paid to soil structure rather than to a mechanical analysis.

1328* Wallace, H. R.

Emergence of Larvae from Cysts of the Beet Eelworm, *Heterodera Schachtii* Schmidt, in Aqueous Solutions of Organic and Inorganic Substances.

Ann. Appl. Biol. 1956, **44,** 274–82.

The rate of larval emergence from cysts of the beet eelworm in a variety of aqueous solutions containing organic and inorganic substances is significantly higher than the emergence rate in water. It is suggested that differences between larval emergence rates in monoamino-monocarboxylic amino-acids may be related to the lipid solubility of these substances and their ability to penetrate the egg membranes. The larval emergence rate in fructose, glucose, sucrose and maltose was significantly higher than that in water, but in raffinose, arabinose and xylose the rate of emergence was no higher than in water. A high rate of larval emergence occurred in sodium chloride, potassium chloride and mercuric chloride, but not in magnesium chloride or calcium chloride. Experiments with several other organic solutions are described. There is an optimum concentration for larval emergence in beet diffusate. The osmotic pressure of the diffusate when maximum emergence occurred was 0·48 atm. Measurements of shrinkage of unhatched larvae in various concentrations of urea, sodium chloride and sucrose showed that decreasing rates of emergence at higher concentrations may be due to changes in the unhatched larvae brought about by an osmotic effect. High concentrations of beet diffusate may have a similar effect.

1300* Wallace, H. R.

Migration of Nematodes.

Nature, Lond. 1956, **177,** 287–8.

An apparatus is described for the study of nematode migration in moist sand under controlled conditions of pressure deficiency. Results showed that migration of the stem eelworm, *Ditylenchus dipsaci* from the site of inoculation was low in saturated sand but increased as pressure deficiency increased, to a maximum at the point where about 25 per cent of the pore space was occupied by air. The peak for migration corresponded approximately to the point of inflexion of the moisture characteristic of the sand. Further increases in pressure deficiency resulted in a decrease in eelworm migration.

1315* Wallace, H. R.

Soil Aeration and the Emergence of Larvae from Cysts of the Beet Eelworm, *Heterodera Schachtii*, Schm.

Ann. Appl. Biol. 1956, **44,** 57–64.

Moisture content, pore size, depth and oxygen consumption in the soil, which influence soil aeration, have been studied in relation to larval emergence from cysts of the beet eelworm. Experiments show that the rate

† Work carried out at the D.S.I.R. Ditton Laboratory, Larkfield, Maidstone.

of larval emergence increases with aeration. In studies of larval emergence in the field emphasis should be laid on soil structure rather than on a mechanical analysis. Those factors associated with good soil tilth favour high rates of larval emergence.

1341* WILLIAMS, T. D.

Resistance of Potatoes to Root Eelworm.

Nematologica. 1956, **1,** 88–93.

The material used at Cambridge for the study of resistance to the potato root eelworm (*Heterodera rostochiensis* Woll.) comprises plants of *Solanum vernei* and plants of several lines of *Solanum tuberosum* sub. sp. *andigenum* from the Commonwealth Potato Collection.

A suggested scheme of categories of resistance is described.

The bearing of root diffusate production on this scheme is discussed, together with results of hatching tests conducted with diffusates from a number of lines of resistant plants. All resistant plants so far examined show some evidence of active diffusate production and many produce a strongly active diffusate.

Examination of roots of resistant plants exposed to infection by the eelworm shows that all resistant plants so far looked at are invaded to some extent. Many are invaded as heavily as susceptible plants. Very few females develop on the resistant plants although many adult males occur. When the females do mature on these plants, " giant cells " are found associated with them just as in the susceptible plants.

Results are given of studies on the larval invasion of resistant plants. The proportions of larvae which have just entered the root, and those which have undergone further development, are related to the age of the roots examined. Investigations to date on the invasion of *Solanum vernei* suggest that there is little development beyond the stage at which the larvae first enter the roots, though further work on this is in progress.

Some suggestions are made concerning future possible uses of potato plants resistant to root eelworm in the study of variations in the sex ratio of *Heterodera rostochiensis.*

1340* WILLIAMS, T. D. & WINSLOW, R. D.

A Synopsis of Some Laboratory Techniques Used in the Quantitative Recovery of Cyst-forming and other Nematodes from Soil.

Contr. to Soil Zoology. Ed. by D. K. McE. Kevan. Pp. 375–84. (Butterworths Sci. Publ., London, 1955. 55s.).

A selection of techniques developed by various workers including the authors.

Details are given of methods for recovering eelworm cysts and non-cyst-forming nematodes from infested soil, and also of a method for opening cysts which prevents over-squashing of the enclosed eggs and larvae. Procedures for estimating numbers of eggs and larvae of *Heterodera* spp. and other plant-parasitic nematodes in aqueous suspensions are described.

A brief account is given of the method for estimating the number of larvae emerging from batches of cysts placed in root diffusate, and of the use of root diffusates from different host plants as an aid to identification of eelworm species in a mixed sample.

The use of a macerator in conjunction with an acid fuchsin lactophenol stain for estimating the numbers of eelworms in plant roots is also described.

1302* WINSLOW, R. D.

Experiments on the Control of the Potato Root Eelworm by Trap Cropping with Black Nightshade.

Plant Path., **4,** 139–40.

Experiments are described in which black nightshade (*Solanum nigrum* L.) was grown as an enemy or trap crop for potato root eelworm (*Heterodera rostochiensis* Woll.). Black nightshade produces a root diffusate which causes a hatch of the eelworm eggs, the roots are invaded by the larvae but development of the larvae is not completed. Where black nightshade was grown on infested land, there was a reduction in the egg content of the cysts compared with fallow plots and a marked reduction in the number of hatchable larvae. Even so, the use of this noxious weed as a trap crop does not appear to be economically feasible.

1331* WINSLOW, R. D.

Seasonal Variations in the Hatching Responses of the Potato-root Eelworm, *Heterodera rostochiensis* Wollenweber, and Related Species.

J. Helminth. 1956, **30,** 157-64.

There is a winter dormancy in the hatchability of some species of *Heterodera.* The dormancy varies in degrees with eelworm species, being slight in the case of beet eelworm amd more pronounced in the case of potato-root eelworm and some other species. It is not wholly dependent on immediate environmental conditions but possibly is induced by previous conditions. The dormancy can be shortened by storing infested soil at certain temperatures, but the cessation of dormancy in spring is not necessarily associated with rise in soil temperature.

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JONES, F. G. W. **Beet Eelworm—Report on a visit to Germany and Holland.** *Brit. Sugar Beet Rev.* 1955, **24,** 25-28, 39, 77–9.

1317* JONES, F. G. W. **Soil Population Studies Using Microplots.** *Nematologica.* 1956, **1,** 109–10.

PLANT BREEDING AND GENETICS

HUDSON, P. S.

Agricultural Delegation to Russia.

Seed Tr. Rev. 1956, **8,** 31–5.

The substance is given of an address to the Seed Trade Association of the United Kingdom on 23 January, 1956. A member of the British Agricultural Delegation to Russia in 1955, the speaker described his visits to various institutes engaged in crop breeding and his impressions concerning the status of Lysenkoist genetics.

HUDSON, P. S.

The Harrowing of Lysenko.

Agric. Rev., Lond. 1956, **2** (1), 45–6.

After outlining the principles adopted by Lysenko, the author briefly describes how these principles have recently fallen into disfavour in the U.S.S.R.

HUDSON, P. S.

Soviet Expert Claims Frost-free Variety.

Grower. 1955, **44,** 395–9.

A brief review of the methods and achievements of the Russian vegetable breeder A. V. Alpatjev is given, with special reference to his work on breeding tomatoes for frost resistance.

HUDSON, P. S.

Who Will Win the Potato Races ?

Grower. 1956, **46,** 87–8.

In addition to briefly describing the value of the Commonwealth Potato Collection in breeding varieties resistant to diseases and pests, particularly late blight and eelworm, the author refers to potato breeding in the U.S.S.R., mentioning a talk with S. M. Bukasov who expressed the view that the problem of new races of late blight could probably be overcome by utilising a wider range of wild species, from Argentina and elsewhere in South America, instead of mostly Mexican species.

IRVINE, D. E. G.†

Notes on British Species of the Genus *Sphacelaria* Lyngb.

Trans. Bot. Soc. Edinb. 1956, **37,** 24–45.

British species of the genus *Sphacelaria* are very imperfectly known and further work on them is urgently required. Thirteen species are described and a key is provided for their identification, with some details of their ecology, reproduction and geographical distribution in British waters, particularly for those which occur on the shores of St. Andrews, Fife, Scotland. The record of *S. saxatilis* requires further verification. *S. hystrix* is recorded from British waters for the first time. *S. fusca* is reduced to a variety of *S. pennata* (*S. cirrosa*), and the nomenclature and infraspecific divisions of the latter species are discussed and described in some detail.

RICHENS, R. H.

Elms.

New Biol. 1956, **20,** 7–29.

A popular account is given of the taxonomy and history of *Ulmus* spp. with special reference to English elms.

PLANT ECOLOGY

1332* LAZENBY, A.

The Control of Rushes.

Herb. Abstr. 1956, **26,** 71–7.

A review of present day knowledge on rush control, particular emphasis being laid on the most important weed rush in Britain, the soft rush (*Juncus effusus*).

The nomenclature and distribution of common British rushes are considered in the Introduction. Rush control might be effected by attacking the established plant and/or preventing the establishment of seedlings. Under the heading " Established Plant and Control Measures " effects of drainage, cutting, fertiliser application and grazing management are dealt with in some detail. Other control measures are briefly mentioned.

A consideration of the seed and seedling stages includes a resumé of the occurrence, production, dispersion and conditions for germination of rush seeds, as well as the choice of seeds mixtures for preventing intrusion of seedling rushes and the management of the young sward.

The discussion aims to bring control measures into practical perspective.

SOIL SCIENCE

1320* CHILDS, E. C.

Physical Aspects of Some Concepts in Soil Mechanics.

Proc. Nat. Acad. Sci. (India). 1955, **24A,** 86–92.

The engineer is concerned to know how soil responds to the application of stresses, and his theories are in the main generalisations of observed behaviour. The physicist is concerned in the main to find how the observed behaviour arises, and his theories in the main relate soil mechanics to other, more basic, physical phenomena.

† Work carried out at the Department of Botany, St. Andrews University.

This paper first describes experiments which show that an externally applied mechanical force on a soil mass and an internally applied soil water suction are equivalent in their effects on the shear strength of the soil. It then shows that in non-shrinking sand the concept of surface loads being borne either by solid particles in contact or by pore water is valid, but that in clays such a simple concept leads to a paradox. This simple concept has been widely accepted in the past to relate pore water pressure to overburden pressure ; the conclusions reached on that basis need reviewing.

1313* Childs, E. C.

The Scientific Aspects of Field Drainage.

Sci. Progr. 1956, **44** (174), 208–23.

Drainage is defined to be the steps taken to ameliorate excessively wet soil conditions, without regard to possible repercussions during other than the wet season. The relevant physics of soil water phenomena is reviewed and the manner of development of moisture profiles is described. The different kinds of need for drainage are classified in two main groups, biological and physical, and it is shown that such need must be translated into the requirement of a known moisture content or a known soil water suction before a drainage system can be designed on a rational basis.

Progress of research on the design of drainage systems, given the physical requirement, is reviewed, and the directions in which progress is needed are outlined.

1321* Collis-George, N.

Hysteresis in Moisture Content-Suction Relationships in Soils.

Proc. Nat. Acad. Sci. (India). 1955, **24A,** 80–85.

Two markedly different materials, a constant structure of sintered glass and a colloidal Na-montmorillonite are compared from the aspects of their hysteresis moisture-energy relationships for wetting and drying. The evidence is in favour of, but requires independent substantiation of a variable angle of contact theory contributing about 6% to the hysteresis phenomenon for pores that empty and refill, the major part of the phenomenon being due to the geometry of the system. In non-emptying pores, which can expand or contract, the contact angle theory and the geometrical theory of Haines are inapplicable, and some further explanation, based on the interaction of colloidal particles is required. It is concluded that at least three mechanisms of hysteresis must be concerned in ordinary soils, and that whatever mechanisms are proposed must satisfy the independent domain model of hysteresis put forward by Everett.

1310* Edwards, D. H.

Water Tables, Equipotentials, and Streamlines in Drained Soil with Anisotropic Permeability.

Soil Sci. 1956, **81,** 3–18.

The development of field methods for measuring the permeability of anisotropic soils raises the problem of designing drainage systems for such soils ; clearly there was little point in studying such a problem before necessary field data were obtainable. The method of electric analogues is extended by the device of distortion of the co-ordinates in proportion to the square root of the ratio of the horizontal and vertical permeabilities, and water table configurations and flow are obtained for ratios of 10 and 0·1, for various cases of drain diameter, depth of impermeable flow, and rainfall rate.

1327* Hanley, F. & Ridgman, W. J.

Manurial Requirements of Light Fen Soils. I.

Exper. Husb. 1956, **1,** 1–9.

Experiments are described which show that, on light peaty soils, phosphate and potash are important manurial requirements and are apparently more effective when used together than when used alone. Residual effects from applications of phosphate and potash were found to persist for at least three years, varying with crop and season. Applications of sulphate of ammonia showed little effect (direct or residual) on growth or yield of crops. Even on plots that received liberal dressings of fertiliser crop yields were not of the standard expected on good fen soils, suggesting that other factors as well as nutrient supply may seriously restrict the productivity of these light peaty fens.

1329* Perrin, R. M. S.

Nature of " Chalk Heath " Soils.

Nature, Lond. 1956, **178,** 31–2.

In certain areas on the Chalk there exist shallow, acid soils carrying a peculiar association of shallow-rooted calcifuges and deep-rooted calcicoles. Such associations are usually called " Chalk Heaths ". Comparison of the mechanical and mineralogical compositions of these soils with the insoluble residues of chalk shows that the topsoils are derived, not from the underlying chalk, but from thin films of loess-like drift, mixed with locally derived flints. Examination of soils on other geological formations shows that loess-like drift is very widespread.

1326* Perrin, R. M. S.

Preparation of Oriented Aggregates for Brindley-Robinson Type X-Ray Cameras.

Clay Min. Bull. 1955, **2** (14), 307–8.

Aggregates for mineralogical analysis, using a Brindley-Robinson camera, are best prepared by centrifuging the clay directly onto the specimen slip. A special centrifuge tube for this purpose is described and the advantages of the method are briefly enumerated.

PHILIP, J. R.†

The Concept of Diffusion Applied to Soil Water.

Proc. Nat. Acad. Sci. (India). 1955, **24A,** 93–104.

The development of the theory of diffusion of liquid water is first reviewed, and then it is shown that just as the rate of liquid water movement can be related to moisture gradient, the diffusivity being dependent on moisture content, so can movement in both vapour and surface absorbed phases be related to the gradient of content of liquid water. The total movement obeys a diffusion equation in which the diffusivity is the sum of three terms which are separately calculable. A curve is presented for a particular case (Yolo light clay) showing how the total diffusivity varies with moisture content and how the relative importance of movement in the vapour and liquid phases varies with moisture content.

1297* RIDER, N. E.

An Account of the Development of the Aerodynamic Method for the Evaluation of Natural Evaporation Conducted in Great Britain from 1947 to 1953.

Publ. Ass. Int. Hydrol. **38,** 135–41.

An account is given of several observational programmes designed to test the physical basis of an aerodynamic formula for the computation of natural evaporation from land surfaces first suggested by Thornthwaite and Holzman. It is found that the method is sound but its use should be restricted strictly to those occasions during which the layer of air near the surface is in the adiabatic state. Its general use is permissible if some error may be accepted and certain conditions are observed in the siting of apparatus. Other equations are shown to be capable of providing a more accurate result in conditions other than adiabatic. An outline is given of two investigations in which the method has been applied to the determination of the hourly rates and daily totals of evaporation from a fairly short grass surface and a field of growing oats, and the difficulties likely to be experienced in the application of the method are illustrated by these examples.

1285* RIDER, N. E.

An Instrument for the Continuous Recording of Soil Temperatures at a Number of Depths.

Met. Mag. 1955, **84,** 329–32.

A thermo-electric instrument for the recording of soil temperatures at five depths down to 40 cms. is described. It provides an immediately visible record at a convenient distance from the position of exposure and no power supply, other than a 6v. accumulator, is required. In exposing the instrument little disturbance to the soil or vegetation cover is caused.

1342* YOUNGS, E. G.

A Laboratory Method of Following Moisture Content Changes.

Trans. VIth. Int. Congr. Soil Sci. 1956 (B), 89–93.

A thermal method is described of following moisture content changes in the laboratory which has been used with fair success in the study of moisture profile development.

STATISTICS

1339* WISHART, J.

χ^2 Probabilities for Large Numbers of Degrees of Freedom.

Biometrika. 1956, **43,** 92–5.

Two series expansions are given from which it is possible to calculate to high accuracy the probability that χ^2 exceeds a given value, and the percentage points of χ^2, for large degrees of freedom.

1338* WISHART, J.

' Significant Difference ' in the Analysis of Field Trials.

Agric. Rev., Lond. 1956, **1** (12), 44–6.

WISHART, J.

Statistical Methods. Pp. 111.

Training Centre in Experimental Designs and Survey Techniques of Experimentation. New Delhi, India. F.A.O., 1954.

WISHART, J. & SANDERS, H. G.

Principles and Practice of Field Experimentation.

2nd ed. Pp. vii+ 133, with Tables.

Tech. Commun. No. 18. *Commonw. Bur. Plant Breed. & Genet.* (Commonw. Agric. Bur., Farnham Royal, 1955. 21s.).

As in the first edition, the book is in two parts ; of these Part I—Principles has been almost completely rewritten, while Part II—Practical Considerations has only been the subject of minor alterations. The principal additions in Part I deal with split plots, confounding, lattices and balanced designs, methods which have been greatly developed since the first edition appeared. There are still comparatively few really satisfactory introductions to statistical methods for agricultural research workers unequipped with specialised mathematical knowledge ; the present edition should prove as useful in this respect as its predecessor.

† On sabbatical leave from the C.S.I.R.O. Regional Pastoral Laboratory, Deniliquin, N.S.W., Australia.

MISCELLANEOUS

1345* Buttress, F. A.

The Library of the School of Agriculture, Cambridge.

Quart. Bull. Int. Ass. Agric. Libns. 1956, **1,** 77–81.

This account outlines the growth of the library during the past 60 years, its part in the functioning of the School and its service to an ever increasing agricultural public.

Engledow, F. L.

Food Processing : its Prospects and Problems.

Food Tr. Rev. 1956, **25** (August), 3–5.

Food processing, more ancient than agriculture, has been governed in development by many natural influences, of which some four or five have always been primary. The first, " seasonality ", is the occurrence of an off season of the year, and a very favourable production season, and through this, processing for storage first developed. The full implications of " seasonality " in both production and processing have still to be worked out. Concentration of people into sedentary groups, still active, remains another important influence, in response to which there must be wholly new food processing problems. Science has already profoundly affected food manufacture, but its modern advances have scarcely yet begun to affect practical operations. They will not do so unless manufacturers show more initiative in securing their application.

The influence of change in food habits on demand for manufactured food are evidently becoming strong though difficult to predict. Several of the discernible ones are discussed.

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WOODMAN, H. E. **Obituary by Dr A. Eden.** *Agriculture, Lond.* 1956, **62,** 597.
WOODMAN, H. E. **Obituary by Dr R. E. Evans.** *Golden Sheaf.* 1956, **9** (2), 5–6.
WOODMAN, H. E. **Obituary by Dr R. E. Evans.** *Times.* 24 *Feb.*, 1956, *p.* 11.
WOODMAN, H. E. **An Appreciation by Sir James Scott Watson.** *Fmrs' Wkly.* 1956, **44** (9), 50.

BOOKS RECEIVED

THE LIBRARIAN HAS PLEASURE IN BRINGING THE FOLLOWING WORKS TO THE READER'S NOTICE

ADDISON, H. **Land, Water and Food.** Pp. XII + 248, with 36 Charts, Diagrams and Sketch-maps. (Chapman & Hall, London, 1955. 18s.).

ASDELL, S. A. **Cattle Fertility and Sterility.** Pp. VIII + 227, with 50 Figs. (J. & A. Churchill, London, 1955. 42s.).

AUSTERWEIL, G. V. **L'Échange d'Ions et les Échangeurs.** Pp. X + 327 with 93 Figs. (Gauthier-Villars, Paris, 1955. Unbound 2,800 Fr. Bound 3,000 Fr.).

AZZI, G. **Agricultural Ecology.** Pp. XV + 424, with 47 Figs. (Constable, London, 1956. 45s.).

BAINER, R., KAPNER, R. A. & BARGER, E. L. **Principles of Farm Machinery.** Pp. XII + 571, with numerous Figs and 7 Appendices. (Wiley [Chapman and Hall, London], 1955. 70s.).

BARNES, H. F. **Gall Midges of Economic Importance. Vol. 7. Gall Midges of Cereal Crops.** Pp. 261, with 7 Figs, 16 Plates and 526 Refs. (Crosby Lockwood, London, 1956. 21s.).

BARRON, N. **Dairy Farmer's Veterinary Book. 2nd ed.** Pp. 269, with 1 Chart and many Illus. (Dairy Farmer (Books) Ltd, Ipswich, 1956. 21s.).

BAVER, L. D. **Soil Physics. 3rd ed.** Pp. XVII + 489, with 106 Figs and 65 Tables. (Wiley [Chapman and Hall, London], 1956. 62s.).

BELLERBY, J. R. *and others.* **Agriculture and Industry Relative Income.** Pp. XII + 369, with 65 Tables. (Macmillan, London, 1956. 30s.).

BENEDICT, M. R. **Can we Solve the Farm Problem?** Pp. XX + 601, with 42 Tables and 5 Appendix Tables. (Twentieth Century Fund, New York, 1955. $5.).

BENOY, W. G. **Farm Buildings. Conversions and Improvements.** Pp. VIII + 141, with 75 Illus. (Crosby Lockwood, London, 1956. 28s.).

BORRADAILE'S **Manual of Elementary Zoology. 12th ed. rev. by W. B. Yapp.** Pp. VIII + 769, with 554 Figs. (Oxford Univ. Press, London, 1955. 30s.).

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CHEKE, V. & SHEPPARD, A. **Cheese and Butter.** *Countryman Library. No.* 10. Pp. 120, Illus. (Hart-Davis, London, 1956. 9s. 6d.).

CHRISTIDIS, B. G. & HARRISON, G. J. **Cotton Growing Problems.** Pp. VIII + 633, with 168 Figs. and 72 Tables. (McGraw-Hill, London, 1955. $9.75.).

CRAMPTON, E. W. **Applied Animal Nutrition.** Pp. XX + 458, with 15 Charts and 86 Tables. (Freeman [Bailey Bros. & Swinfen, London], 1956. 55s. 6d.).

DIGGINS, R. V. & BUNDY, C. E. **Beef Production.** Pp. X + 335 with 210 Figs. (Prentice-Hall [Bailey Bros. & Swinfen, London], 1956. 47s.).

DORFMAN, R. I. & SHIPLEY, R. A. **Androgens. Biochemistry, Physiology, and Clinical Significance.** Pp. XVII + 590, with many Figs and Tables and 4 Appendices. (Wiley [Chapman and Hall], London, 1956. 105s.).

DOUGLAS, J. S. **Hydroponics. The Bengal System. 2nd ed.** Pp. XII + 153, with 29 Illus, 15 Figs, 10 Tables and 3 Appendices. (Geoffrey Cumberlege, Bombay, 1955. Rs. 7.).

DUKES, H. H. **The Physiology of Domestic Animals. 7th ed.** Pp. XII + 1,020, with 238 Figs, 35 Tables and Appendix. (Baillière Tindall & Cox, London, 1955. 80s.).

ECKLES, C. H. & ANTHONY, E. L. **Dairy Cattle and Milk Production. 5th ed.** Pp. XX + 587, with 101 Figs and 74 Tables. (Macmillan Co., New York [London Branch], 1956. 42s.).

EDGERTON, C. W. **Sugarcane and Its Diseases.** Pp. X + 290, with 39 Figs and 669 Refs. (Louisiana State Univ. Press, Baton Rouge, 1955. $5.).

Farmer and Stock-Breeder Year Book and Desk Diary, 1957. Pp. 370, Illus. (Farmer and Stock-Breeder, London, 1956. 12s. 6d.).

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FOURMONT, R. **Les Variétés de Pois Cultivés en France.** Pp. 254, with 16 Figs, 79 Plates and 9 Coloured Plates. (Inst. Nat. Rech. Agron., Paris, 1956. 1,750 Fr.).

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GOOD, R. **Features of Evolution in the Flowering Plants.** Pp. XV + 405, with 162 Figs. (Longmans, Green & Co., London, 1956. 30s.).

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LI, C. C. **Population Genetics.** Pp. XII + 366, with 82 Figs and 82 Tables. (Univ. Chicago Press [Cambridge Univ. Press, London], 1955. 75s.).

McCULLOCH, A. W. & SCHRUNK, J. F. **Sprinkler Irrigation. 1st ed.** Pp. 466, with Figs, Tables and Appendices. (Sprinkler Irrigation Assoc., Washington 6, D.C., 1955. $8.00 [$6.50 to Libraries]).

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OLDHAM, C. H. **Black and Red Currants.** Pp. 136, with 31 Figs. (Littlebury, Worcester, 1956. 15s.).

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